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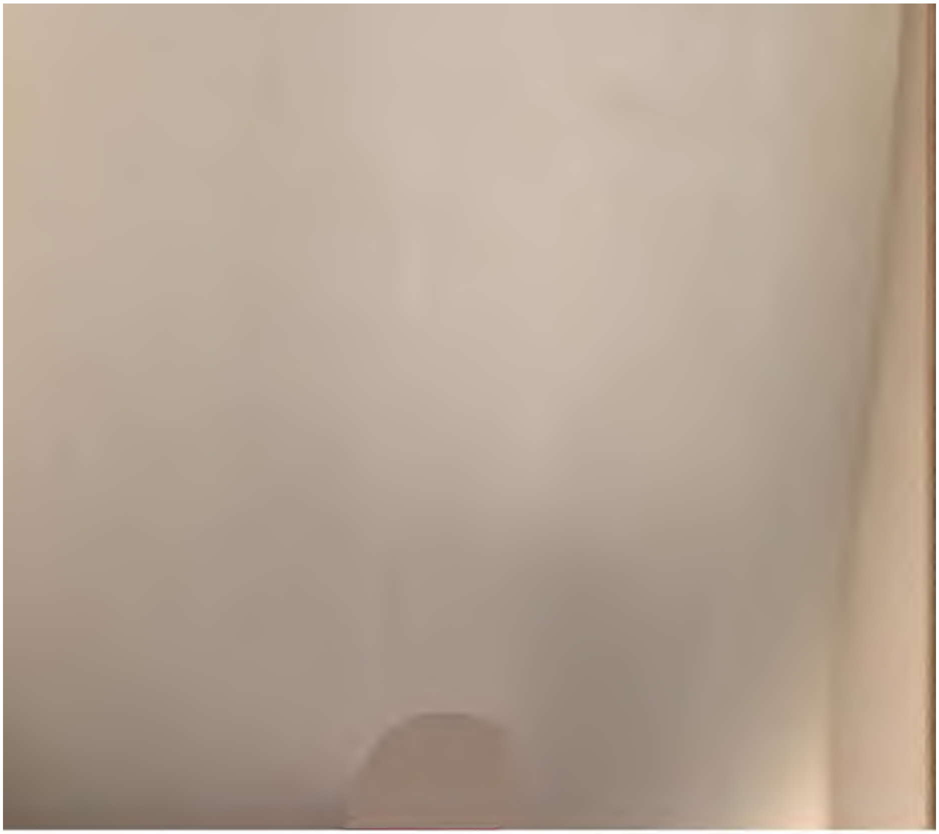

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THE

POPULAR SCIENCE

MONTHLY.

NOVEMBER, 1889.

THE ART OF COOKING.*

By EDWARD ATKINSON, LL.D.

THE cost of materials which are used for food comes to one half or more of the average income of at least ninety per cent of the people of this country; yet our product of food material is more abundant in ratio to population than that of any other country which holds a prominent position in the civilized world. This food consists in greatest measure of grain, meat, dairy products, and roots or tubers; in small part of fish, green vegetables, and fruit. The greater part of this food must be converted into a digestible and appetizing form by the application of heat to it at the right temperature, the degree varying with different kinds of food; this heat must be applied for a suitable time, also varying with the kind of material which is to be converted into a nutritious form by its action. Yet there are no popular treatises or definite instructions on the scientific application of heat to food.

Good health depends in greater measure upon adequate nutrition and upon the conversion of food material into a digestible form than upon any other factor in life. A well-nourished man can bear adverse conditions of life in the dwelling-house, the factory, the mine, and the furnace, to which the ill-nourished man will succumb in a very short time. On the other hand, the capacity of the man to perform his work is as fully dependent upon the quality and adequacy of his food as the capacity of the horse, ox, or mule. The force of the man depends on his food as much as the force of the engine upon the fuel used under the boiler; this is almost as true as to mental as it is to physical power.

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* This essay has been prepared for the American Public Health Association: delivered at their meeting in Brooklyn, October 23, 1889. With their consent it is published in this number of "The Popular Science Monthly."

There are innumerable treatises upon the feeding of animals; upon the generation of steam; upon the construction and ventilation of buildings; upon the arts which relate to clothing the human body, and upon keeping the dwelling and workshop warm; and, lastly, yet more numerous treatises or cookery-books upon the art of mixing and preparing the food which is to be cooked; there are also many treatises, chemical and physiological, upon the subject of nutrition, and there are one or two treatises on the science of cooking, notably Dr. Mattieu Williams's "Chemistry of Cookery"; yet, so far as the writer has been able to ascertain the facts, there is no receipt-book or cookery-book in common use which deals with the actual art of cooking by directing the right
application of heat for a suitable time and at a suitable degree, t
the specific food which is to be converted into a nutritious for
by the conversion of its elements into new forms or conditions b
the action of heat upon it.

It is possible that greater attention has been given to this m
ter in England than in this country. After trying in vain to
an oven thermometer in the United States, I lately importe
from England, made by Joseph Davis & Co., Fitzroy Works
don, S. E., and purchased at an agricultural show at reta
seven shillings sixpence, gauged at 200° to 600° Fahrenhei
this thermometer are marked the respective degrees to whi
ous kinds of food should be subjected, as follows:

Pork	320°	Fahr.	Puff pastry	34
Veal	320	"	Bread	34
Beef	310	"	Pastry	32
Mutton	300	"	Meat-pie	2

These figures agree substantially with my own expe
to the maximum of heat, but I do not concur with th
that less than 200° Fahr. may not be permitted, if ti
for the lower degree of heat to do its work. On the c
kinds of very tough meat may be reduced to a very
tion by the long application of heat at 180° to 200°,
flavor or nutritious property, provided the food be
stantially air-tight vessels. The testimony of Dr.
iams is conclusive on this point, as well as the spe
of the few good cooks of the method of simm
guished from boiling. Meats and grains may be
cooked at less than a boiling heat, and eggs s
while most kinds of roots, tubers, and vegetables
degree.

I venture now to give some of the general c
have reached by the application of somewha

inventions on which I have experimented personally in such scraps of time as I could spare from my regular occupation, and on nearly two years' use of my apparatus in my own family.

I will challenge attention and discussion by first submitting some very positive and dogmatic statements, subsequently sustaining them by such proofs as I have to offer:

1. Special apparatus for boiling and frying has been adequately and suitably developed for the use of those who can afford these somewhat wasteful methods of preparing food, yet excellent when skillfully practiced.

2. The ordinary methods of frying are utterly bad and wasteful.

3. Bread may be baked suitably in a brick oven, and also economically, when the work is done upon a large scale.

4. It is very difficult to bake bread in a suitable way in the common iron stove or range; for this, among other reasons, most of the bread consumed in this country is very bad, although we have the greatest abundance of the best material.

5. Meats may be well roasted in a costly manner before an open fire.

6. Aside from the exceptional apparatus or methods named, substantially all the modern cooking stoves and ranges are wasteful and more or less unsuitable for use. All the ordinary methods of *quick* baking, roasting, and boiling are bad; and, finally, almost the whole of the coal or oil used in cooking is wasted.

7. The smell of cooking in the ordinary way gives evidence of waste of flavor as well as a waste of nutritious properties; and in most cases the unpleasant smell also gives evidence that the food is being converted into an unwholesome condition, conducive to indigestion and dyspepsia.

8. Nine tenths of the time devoted to watching the process of cooking is wasted; and the heat and discomfort of the room in which the cooking is done are evidence of worse than waste.

9. The warming of the room or house with the apparatus used for cooking is inconsistent with the best method of cooking, and might be compassed at much less cost if the process of cooking were separated from the process of warming the room or dwelling.

10. No fuel which can not be wholly consumed is fit to use in the process of cooking, and any chimney which creates a draught upon the fuel when in the process of combustion, like the ordinary chimney of a house, is worse than useless, since it wastes the greater part of the heat generated from the fuel.

The true science of cooking consists in the regulated and controlled application of heat by which flavors are developed and the work of conversion is accomplished. For this purpose a quantity of fuel is required which is almost absurdly small compared to the quantity commonly used.

Compare the ordinary method of using fuel for cooking with the scientific use of fuel for the development of power in the steam-engine.

The sheet of lightly sized linen paper abstracted from the unused part of an old ledger, on which I am now writing the first draught of this essay, measures $13'' \times 9'' = 117$ square inches, and weighs half an ounce. In solid form it measures half a cubic inch. If consumed under the boiler of the modern marine steam-engine such as is used in the freight-steamers that carry our wheat to England, two sheets of this paper in a solid form would be equal to seventy-one per cent of the calorific value of a cube of bituminous coal of the same size, and would drive a ton of wheat and its proportion of the steamship $1\frac{4}{10}$ miles on the way from the producer to the consumer at the present standard of power developed from coal. Yet not over twelve per cent of the actual power of the heat which this scrap of paper will yield would even then be actually converted into work. A cube of pure wood-pulp of the same size will do the same work. On the other hand, wood-pulp until ignited is the best available non-conductor of heat; I therefore build my ovens in greater part of wood-pulp prepared so as not to ignite at any degree of heat which is necessary for cooking; but even in my oven it requires one quart of oil, measuring a fraction under fifty-eight cubic inches, to cook fifty to sixty pounds of bread, meat, and vegetables in four successive charges occupying two hours each. Compared with the application of heat to the development of power, even my oven must be utterly condemned as wasteful of fuel; but compare my quart of oil with the hodfuls of coal that would be required to cook sixty pounds of food in the common range or stove, and then what is the verdict?

I now venture to submit the data of a dinner prepared by myself, but little out of the usual course, as an example of the common practice in my own family, and of what may be done substantially with one lamp. The dinner was provided for my own family of seven persons, with five guests, and it also sufficed for four servants—sixteen in all—with something left over. My summer kitchen is fitted with a cooking-stove, as it is more convenient to use the top of the stove, heated with hard-wood chips, for boiling water, heating the soup, and boiling potatoes, than it is to use a kerosene-oil stove of the common kind; on this stove the soup made the day before in the Aladdin cooker was reheated, the potatoes were boiled, and the hot water was provided.

The dinner cooked in the Aladdin oven consisted of three to four pounds of fresh blue-fish, just caught, cooked in imitation of broiling, one hour; six to seven pounds leg and loin of lamb, roasted one and three fourths hours; three tame ducks, weighing about seven pounds, roasted one hour; squash cooked in its own juice, with but very little water, one and three fourths hours; stuffed tomatoes cooked three quarters of an hour; a large apple *soufflé* pudding baked one hour.

The oven having been previously heated one hour, the lamb and the squash were first put in; later the fish was added; while these were being served, the ducks and the pudding were being cooked; the use of the lamp for the whole service was four hours; the oil consumed, one pint, cost less than two cents; the cook's estimate of the coal which would have been required for the dinner had it been cooked in the large stove which has been used in other years, at one and a half to two ordinary hodfuls.

This was an every-day dinner, to which my guests had been invited in order that they might test our common practice.

I assume that the effect of heat upon food material is what may be called chemical conversion, accompanied, when the heat is applied at a low degree only, by partial evaporation of water, but when applied at a high degree, by partial distillation of the juices, by the cracking or dissociation of the fats, and by the diffusion of the volatile parts of the food in bad smells with loss of flavor and waste of some of the nutritious properties of the material. If the cracking or dissociation of the fats is carried to a point which is very common in iron stoves and ranges, the residuum of the fat becomes very indigestible and positively unwholesome. When rightly cooked and not cracked or dissociated, a certain portion of fat is absolutely necessary to adequate nutrition. Is it not true that we take into our stomachs a great deal too much fat, and that it is eaten in the most injurious form?

The preparation of the coffee-berry is the most familiar example of the development of its properties by the right application of heat. If the berry is dried, ground, and made into an infusion without being roasted, no true or drinkable coffee can be made from it. If overheated and burned, the infusion is acrid and unwholesome. But when the berry is carefully roasted and ground, the infusion makes true coffee. The flavor and other properties are the actual product of the heat, when scientifically applied. The flavor of the pea-nut is developed in the same way. In the treatment of grain, none yields so great a difference in flavor, according to the method of cooking, as the meal of maize or Indian corn; but I find the wheaten bread, whether made of whole or of bolted flour, yields a much finer flavor when baked two or three hours in my pulp oven at 250° to 300° Fahr., than when quickly baked in a common stove or range in one hour at an unknown but admittedly much higher degree of heat. The flavors of the white kinds of fish, such as cod, haddock, flounder, scup, and the like, which are much impaired by the ordinary methods of cooking, are very finely developed when slowly cooked in my oven; and, lastly, all kinds of meat and poultry develop their respective flavors in the most appetizing manner when roasted in my pulp oven at such low degrees of heat as not to give off any smell or to dissociate any of the volatile elements of the juices or fats, while for game nothing can equal it. Quail and partridge come out rich, juicy, and of almost too full a flavor.

I have frequently served dinners or lunches of four or five courses—soup made the day before, reheated; fish, meat, game, potatoes, cauliflower, asparagus, onions, tomatoes, and custard pudding—all cooked in the same oven at the same time in the dining-room, and served from the oven to the table in the china or earthen dishes in which each had been cooked; the only difference between one dish and another being in respect to the time in which it had been subjected to the heat of the lamp or lamps, yet without the least flavor or taint being carried from one kind of food to the other.

It will be apparent that, if cooking can be done in this way, the whole art will consist in preparing the food according to written or printed receipts, and in determining the degree of heat and the time to which these dishes should be subjected. No watching is needed, and indeed none is possible without danger of cooling off the oven by opening it too often. Of course, it is better to use two ovens than one, devoting one to meat and fish, served by a lamp of moderate power for the right period of time, and the other served by a lamp of higher power for cooking vegetables, puddings, and pastry.

My Aladdin ovens, so called, are adapted to methods of cooking corresponding to broiling, roasting, baking, and braising; but they can also be used for boiling and simmering.

My Aladdin cooker, so called, in which the heat is conveyed through water, is devoted wholly to boiling, stewing, and simmering, especially the latter. I neither attempt nor desire to *fry* anything in either kind of apparatus. About nine tenths of all the cooking of my somewhat large family has been done with this apparatus for nearly two years, and I also have an office lunch-room for the use of about twenty employés, in which no other apparatus is or can be used. My summer kitchen at my sea-side house is fitted with a grill which is very seldom used; it proves to be most convenient to use the cooking-stove, heated with hard-wood chips, for boiling the water for tea and for occasional frying.

My winter kitchen is a large one, and it depends upon the range for warming it. The range, therefore, continues to be used to some extent for cooking, mainly for preparing breakfast, but I contemplate substituting a special stove without any oven, which will heat the room with much less coal, the top of the stove being fitted for cooking in the ordinary way. Neither the oven of the stove in summer nor of the range in winter are now used for cooking; therefore, the kitchen is never overheated and the food is never spoiled. We have occasionally failed to cook a large joint of meat for a sufficient time, but we have never spoiled a dish in the process of cooking since the pulp or jacketed oven was adopted.

What, then, are the simple principles of the science of cooking? I think they may be stated in a few very plain terms:

1. The heat should be derived from fuel which can be wholly consumed or wholly converted into the products of complete combustion without any chimney except that of the lamp or burner. The fault with coal, especially anthracite, is, that it is not evenly or fully consumed; hence the need of a chimney to take away the gases developed and not wholly consumed; but the chimney also carries off the greater part of the heat. It is very evident that the crude combustion of coal and the direct application of the heat generated will ere long give way to more scientific methods of consuming the gaseous products and of deriving the heat from the final combustion of the gaseous products in all arts. In the matter of cooking, kerosene-oil burned in any one of the types of lamp which have a central duct to convey oxygen from below to the inner side of a circular wick, when properly trimmed and served with well-distilled oil, gives substantially perfect combustion.

The same may be said of illuminating gas when used in one of the burners of the Bunsen type which supply an excess of oxygen and yield the blue flame.

The combustion of oil and of gas can be brought under absolute control by gauging the size of wick or burner to the work to be done.

2. The oven in which the food is to be subjected to this measurable and controllable source of heat must be so constructed that the heat imparted to it may be entrapped and accumulated up to a certain measure or degree and then maintained at that temperature without substantial variation until the work is done. This can be done by jacketing the oven in a suitable way with material which is incombustible and also a non-conductor of heat.

3. There should be no direct communication between the true oven or receptacle in which the food is placed and the source of heat, lest the products of incomplete combustion should sometimes taint the food, and lest the food should be exposed to being in places burned or scorched.

These three conditions are all accomplished in the two somewhat crude and probably incomplete inventions which I have named the "Aladdin Cooker" and the "Aladdin Oven," in both of which the heat derived from common lamps, such as are used for lighting, may be stored or accumulated so as to do the work of cooking in a very perfect manner. In the cooker the heat is imparted to water in an attachment to a metal-lined wooden box corresponding to the water-back of the common range or stove, and the work is done by the contact of the hot water with the outside of the porcelain vessels in which the food is placed, or by the steam generated when the water is heated to the boiling-point.

In the oven a column of heated air is carried from the chimney of the lamp to the inside of an outer oven made chiefly of prepared wood-pulp, but outside of the inner sheet-iron or metallic oven in which the food is placed, which inner oven is separately ventilated.

I do not claim any originality in these simple principles or in the idea of jacketing an oven with non-conductors of heat. All these matters are well understood by every intelligent stove-manufacturer, but it is practically impossible for any one to apply them in making stoves such as will meet the demand of the market, for two reasons:

1. The greatest demand for stoves is that of people of very moderate means, who are too much controlled by the price in making a choice, making the common error in confounding cheapness with low price, an error which leads to great waste not only in the matter of stoves but in many other ways.

2. The absolute and imperative preference of the public for a stove in or upon which the work can be done very quickly.

The custom of cooking quickly is in part a matter of choice, and in part due to the necessity to which a great many working people are subject to cook their meals quickly or else to go without hot breakfasts and dinners.

Another great obstruction to improvement in the art of cooking is the almost universal misconception that the finer cuts of meat are more nutritious than the coarser portions, coupled with an almost universal prejudice among working people against stewed food. This prejudice is doubtless due to the tasteless quality of boiled meat; boiling toughens each of the fine fibers, and deprives the meat almost wholly of its distinctive flavor.

All these blunders and misconceptions must evidently be removed before any true art of cooking can become common practice.

The more necessary, however, does it become to invent apparatus in which meat can only be simmered and can not boil, as in the Aladdin cooker, and also to invent a stove or oven in which neither meat nor bread can be overcooked, dried up, or rendered indigestible by too much heat, as in the Aladdin oven.

Next, people must be persuaded that a better and more nutritious breakfast can be made ready to eat, as soon as the family are out of bed, by putting meat stews, oatmeal, brown bread, and many kinds of puddings, into the cooker, and simmering all night by the use of a single safe lamp, than in any other way.

People must be taught that the dinner can be put into the oven when both husband and wife go to the mill to work, and so treated that it may be found perfectly cooked at noon, without requiring any attention in the interval.

People must be taught that the best of bread, raised with good yeast, can be mixed and kneaded between 12.30 and 1 P. M., placed in a bread-raiser, which will raise it ready for the oven at 6 or 7 P. M., and that this bread may be perfectly baked in two hours by the heat of the evening lamp, which at the same time serves to give light for reading or sewing.

All this can be accomplished with my crude apparatus, but, until some skillful stove-makers take up these inventions and make the ovens in large numbers at low cost, my own efforts must be directed mainly toward ameliorating the condition of the rich, saving the houses of the well-to-do from the heat and smell of the present bad methods, and in this way creating a demand for my ovens which, while made in small numbers by hand-work, are too costly for general use, although in an ordinary family they will pay for themselves in six months.

I have ventured to call the attention of the Public Health Association to these matters, because I have been led, by the study of the statistics of the cost of subsistence, to certain conclusions which are wholly in the line of your work.

I venture to ask you if it is not a fact that bad and wasteful methods of consuming food are not a most potent cost of inability to work to the best advantage? Are they not more promotive of disease, and, in fact, a more subtle cause of want in the midst of abundance, than even the waste on fermented and spirituous liquors?

From my own observations, I am of the opinion that dyspepsia is a cause of more disability than intemperance, although this proposition is not capable of statistical demonstration.

Material life consists in the conversion of forces, or in the application of material products, to the supply of the necessities of life. In the line of absolute necessity food comes first, clothing next, and shelter third. The supply of the materials for meeting these needs of the body is superabundant; comfort and welfare depend upon the relative proportion of the materials used, or upon the direction which may be given to the conversion of these forces. The result of each year's work is a given product; whether that product shall be adequate or otherwise depends almost wholly upon individual intelligence. In respect to the great majority of all who perform the actual manual or mechanical work of production, if the expenditure for food and drink is unduly large, then either clothing or shelter must be restricted; a small part of the waste of food, on which half the income is spent, might, if saved, enable the family to double the expenditure for a dwelling-place. It follows that the most difficult question with which practical reformers are called upon to deal, viz., that of providing more ample and comfortable dwellings, may be solved by altering the conversion of the present product, even if that may not be increased, so that what is now in part wasted on food and drink may be spent for better shelter, and yet the family may be more fully nourished than at present. I do not claim absolute accuracy for the following proportion of expenses in workingmen's families, but I am quite sure they are near enough to the mark to serve as an example.

In a family of five adults, or of four adults and two children ten or under, making an average family of five persons, in which one half the income is spent for food and fuel, twenty-five cents a day per adult being spent for food, the corresponding average expenditure per adult:

For clothing will be	7 to 9	cents.
For liquor it may be	2 to 4	"
For sundries it will be about	5	"
And the remainder for rent or shelter, if no liquor is used	9 to 11	"
If liquor is used	7 to 9	"

Now, I think it is very safe to put the waste of food material at twenty per cent, or five cents a day; if this misspent force and one half the average cost of liquor, or two cents a day, could be converted into shelter—that is to say, to providing a more ample dwelling by either buying or leasing—it would suffice to enlarge the present quarters by one half to three fourths. Five cents a day per adult comes to $1,000,000,000 or more a year, counting two children of ten or under as equal to one adult. But the greater benefit which would come from a true art of preparing food would consist in the increase of the productive force of the community, so that the provision for dwelling might be increased both absolutely and relatively. I might add another treatise to this, on the waste of force in bad building and from the common practice of what I have named the art of combustible architecture; but time will not serve. Suffice it that the product of this nation is more than ample for the abundant subsistence, the adequate shelter, and the complete clothing of every family in it; yet we witness want in the midst of plenty, because we waste enough to support another nation at the standard of French economy and thrift, especially in the matter of food.

I may now venture to call your attention to some of the very subtile points which are brought out by the statistical investigation of the food question. I suppose that there is no kind of meat which is consumed so generally or in such large quantity as pork; yet, according to the chemical and physiological data, the conversion of Indian corn into pork, at the rate of one thousand pounds of corn to two hundred pounds of pork, results in a waste of practically all the protein and nearly all the starch, and gives a residuum of fat of which most people get too much in the other kinds of food which they consume. Yet it would be useless to try to abolish pork from the common dietary. I sometimes wonder if the Hebrew lawgivers were not good economists when they condemned the use of pork, or whether they were guided wholly by sanitary considerations.

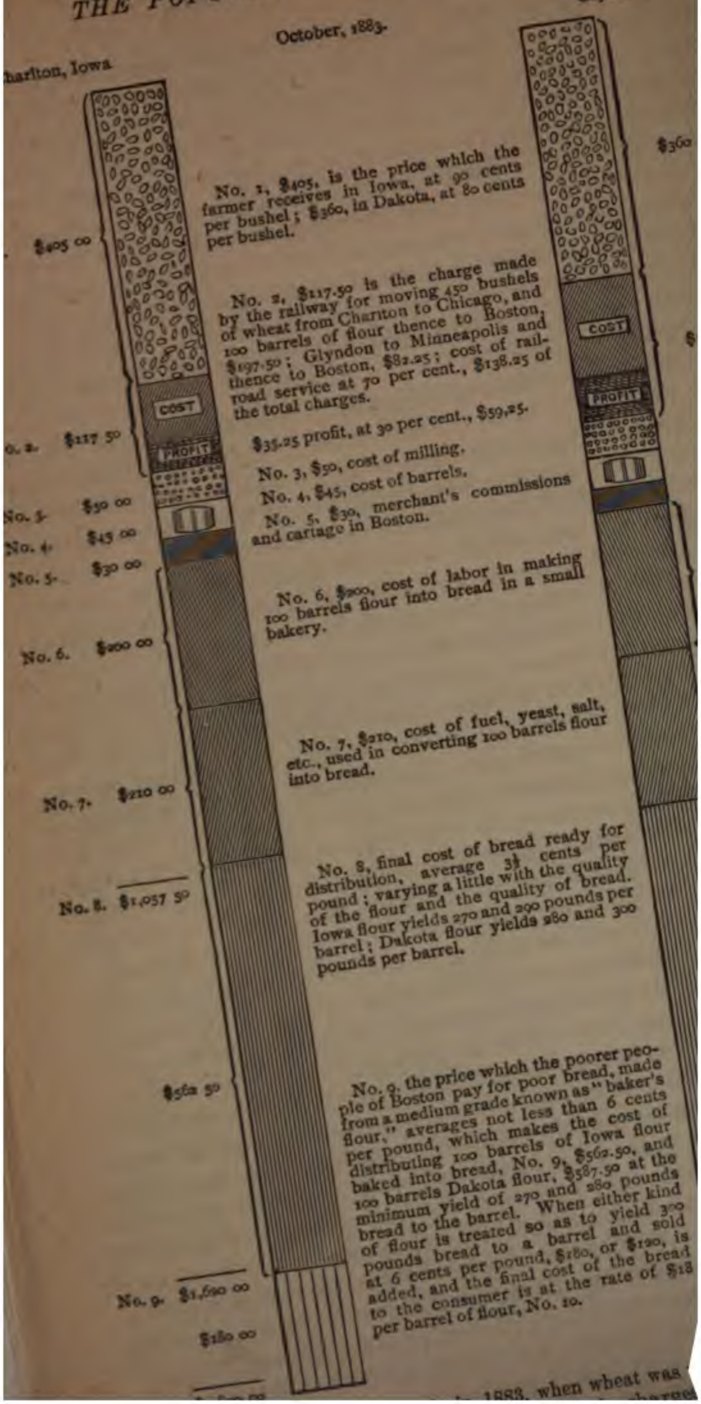
Again, the present crop of wheat calls for fifty thousand tons of twine for binding it upon the self-binding harvester; the cost of binding wheat by hand was five to six cents per bushel, and it required a small army of agricultural tramps who charged almost any price when needed to do this work. The self-binder reduced this charge to not exceeding one cent and a half per bushel. This reduction, which finally took effect two or three years before the resumption of specie payments in this country in 1879, was one of the principal factors in enabling us to export wheat profitably and vastly in excess of anything previously known; and it was upon the margin of exports over imports, consisting wholly of wheat, that we were enabled to import gold in sufficient measure to resume specie payment. Yet this all turned on tying a knot by the machine instead of by hand.

Again, I will present to you my diagram of the loaf of bread, which I have frequently used in other ways. You will observe that, with wheat at about the present price, bread can be made and can be sold in a very large way at three to three and one half cents per pound; but if the bread is distributed in the customary manner by way of small shops or by delivery on the part of the bakers themselves, you will find that the price of bread ranges from five to eight cents a pound, according to the quality.

Now, in this oven made of paper, any person of ordinary intelligence who is willing to devote twenty minutes to kneading bread —which requires more muscle than it does mind—then placing it in the bread-raiser, following a certain rule, taking it out at a given time and putting it in this oven over this lamp, can make better bread at three to three and one half cents per pound than any baker's bread which can be purchased. Here are samples of the bread; you can taste it for yourselves. I devoted two evenings to learning how to make bread; and I baked these loaves, some of which I made myself, by the heat of the evening lamp which lighted my library table while I was reading my evening paper.

I have said that a saving of five cents per day *per capita* might

October, 1883.



No. 1, $405, is the price which the farmer receives in Iowa, at 90 cents per bushel; $360, in Dakota, at 80 cents per bushel.

No. 2, $117.50 is the charge made by the railway for moving 450 bushels of wheat from Chariton to Chicago, and 100 barrels of flour thence to Boston, $197.50; Glyndon to Minneapolis and thence to Boston, $82.25; cost of railroad service at 70 per cent., $138.25 of the total charges.

$35.25 profit, at 30 per cent., $59,25.

No. 3, $50, cost of milling.

No. 4, $45, cost of barrels.

No. 5, $30, merchant's commissions and cartage in Boston.

No. 6, $200, cost of labor in making 100 barrels flour into bread in a small bakery.

No. 7, $210, cost of fuel, yeast, salt, etc., used in converting 100 barrels flour into bread.

No. 8, final cost of bread ready for distribution, average 3½ cents per pound; varying a little with the quality of the flour and the quality of bread. Iowa flour yields 270 and 290 pounds per barrel; Dakota flour yields 280 and 300 pounds per barrel.

No. 9, the price which the poorer people of Boston pay for poor bread, made from a medium grade known as "baker's flour," averages not less than 6 cents per pound, which makes the cost of distributing 100 barrels of Iowa flour baked into bread, No. 9, $562.50, and 100 barrels Dakota flour, $587.50 at the minimum yield of 270 and 280 pounds bread to the barrel. When either kind of flour is treated so as to yield 300 pounds bread to a barrel and sold at 6 cents per pound, $180, or $120, is added, and the final cost of the bread to the consumer is at the rate of $18 per barrel of flour, No. 10.

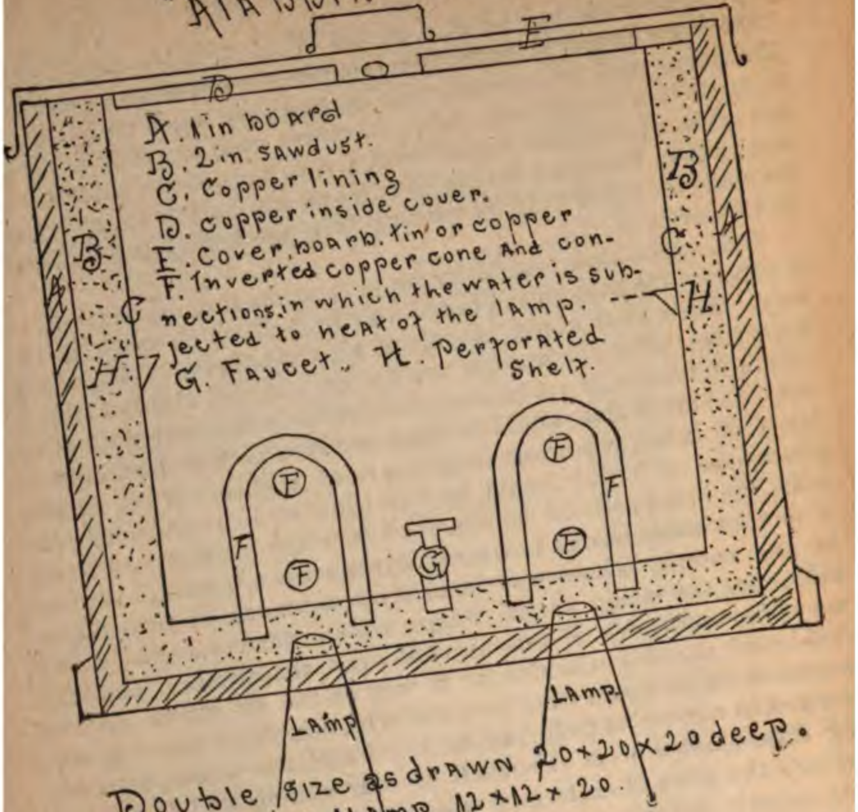
1883, when wheat was

readily be made in the food-supply of an average family. The customary ration is from three fourths of a pound to a pound; in the families of poor people, who depend very much upon bread, I suppose it is one pound. Now, wherever such a family is paying six cents a pound for wheat bread, not an uncommon price among the poor in Boston, a saving of two and one half cents a day can be made on bread only by making it in the family and baking it in this oven.

But, again, this possibility leads to another consideration. It is conceivable that all the bread may by and by be made in this way. Then what would become of all the bakers? They would for a time suffer for want of work; but you will observe that in this as in most of the actual improvements in the conditions of society, the art which would be displaced is one of the most onerous kinds of labor, requiring long hours of night-work; a greater abundance of bread would be furnished at less cost; and presently the bakers would be absorbed in other branches of work. How that happens, and how such adjustments are made, I suppose no one knows. There was formerly one branch of cotton-spinning, viz., the sizing of the warps, which was conducted under very uncomfortable if not unwholesome conditions. The old-fashioned dressing-machine, as it was called, on which all the warps of cotton goods were prepared with starch for weaving, was worked in a room at from 110° to 120° Fahr., the atmosphere being impregnated with the smell of sour starch; and in a given factory the work of eight men was required. In the year 1866 I was myself instrumental in importing two machines of a new kind from Great Britain; these machines were operated in a light, cool, and well-ventilated room; a man and a boy did the work of the eight men. What became of the other seven men? I never could trace them; they were merged in the great body of workmen. The new machine has wholly displaced the old one; and there is now no branch of work in the cotton-mill which is considered injurious, or subject to any great discomfort. In fact, when the final application of invention is made to the cotton-factory by using ice or other methods of cooling the air in summer, as we use fuel to heat the rooms in winter, the atmosphere of the cotton-mill will become about the most salubrious that can be obtained, for the reason that the exact degree of heat and humidity which is called for in the best work in spinning and weaving is consistent with the exact degree required for the health of the human body; and since electric lighting has displaced the noxious vapors of illuminating gas, it may soon become possible to secure workers in a cotton-mill on the ground that a cotton-mill is the best sanitarium.

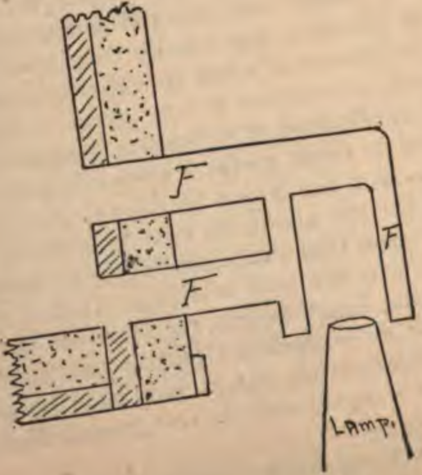
I have given you these last few data, which are not immediately

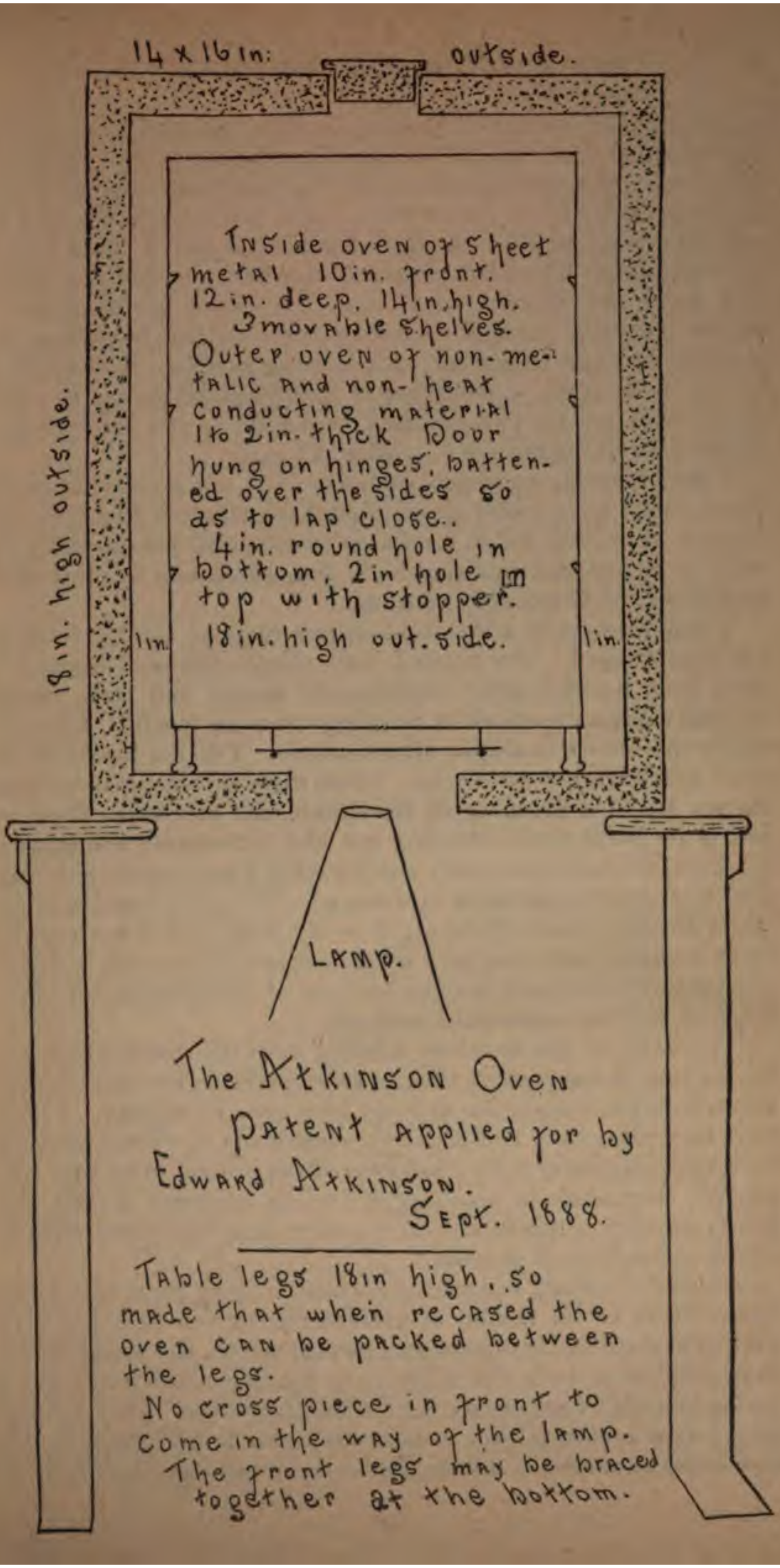
"ALADDIN COOKER"



A. 1 in board
B. 2 in sawdust.
C. Copper lining
D. copper inside cover.
E. Cover board. tin or copper
F. Inverted copper cone and connections in which the water is subjected to heat of the lamp.
G. Faucet. H. Perforated Shelf.

Double size as drawn 20×20×20 deep.
Single size 1 Lamp 12×12×20.
Scale 1/10th to 1in.





Inside oven of sheet metal 10in. front. 12in. deep. 14in. high. 3 movable shelves. Outer oven of non-metalic and non-heat conducting material 1 to 2in. thick Door hung on hinges, battened over the sides so as to lap close.. 4in. round hole in bottom, 2in hole in top with stopper. 18in. high out. side.

The Atkinson Oven
Patent applied for by
Edward Atkinson.
Sept. 1888.

Table legs 18in high, so made that when recased the oven can be packed between the legs.
No cross piece in front to come in the way of the lamp.
The front legs may be braced together at the bottom.

connected with the art of cooking, to show you how "far afield" the figures of food may follow one who tries to find out their full meaning. I will now present to you the diagrams and description of the cooker and of the oven, and will presently invite you to test the quality of the food which has been prepared while I have been speaking. These two diagrams were first prepared in a rough way for a newspaper; the form of the heater to the Aladdin cooker has been changed, and some cross-sections have been introduced in order to increase the heating surface. The Aladdin oven is made at the present time of a different shape and in a different way; but the two diagrams will show to you the two conceptions on which the whole matter is based.

I have a strong suspicion, or I may even say a growing confidence, that I have really accomplished what Count Rumford undertook to do, but which he failed to establish permanently for want of a fuel like kerosene-oil or gas, which can be controlled, regulated, and thoroughly consumed.

I may have spent a thousand dollars more or less in developing this subject. The present very simple forms of apparatus have been adopted after considerable money had been wasted in more complex methods of reaching the same results. I believe this is the course in almost all inventions. I do not intend to become a manufacturer of ovens. I have made an arrangement with Messrs. Kenrick Brothers, of Brookline, who now make them on orders by hand-work, crediting me with a moderate commission from which I may ultimately recover what I have spent, although I have no great expectation of doing so. The ovens cost too much while they are made by hand; it is my hope that some regular stove-manufacturer may take up the subject at the point to which I have brought it, and make a business of introducing my apparatus on strictly commercial methods.

The price of the standard Aladdin oven like these which are before you, at the present time, is twenty-five dollars without the lamp, boxed and ready for delivery to express or railway. I hope they may ultimately be furnished, when made in a large way, for a considerably lower price; but even at the present price they will pay for themselves in economy of fuel, in economy of food, and in the comfort of those who do the work, in a very short term of weeks rather than of months.

I began the study of cooking apparatus many years ago, when endeavoring to aid factory operatives, during the period of very high-priced cotton, in supporting themselves on the wages which they could earn while the mills were running short time; and I had substantially conceived the "Aladdin Cooker," but I did not then follow up the subject so as to enable me to boil water in this apparatus by means of a lamp, kerosene-oil not then having been introduced for such purpose. Moreover, I was under the old superstition that it was necessary to have a heat at or above the boiling-point in order to cook at all. Even Count Rumford found out by accident that meats could be cooked at a lower degree; and it was not until I happened to read Dr. Mattieu Williams's "Chemistry of Cookery" that I was led to develop the Norwegian cooking-box into the cooker with the heating attachment.

Perhaps I unwisely gave way this idea or conception which I might have patented: I had the impression that it would be adopted more rapidly; but the public have become so accustomed to the patent system in this country as to make it almost impossible to give away even an idea. I doubt if this is altogether a wholesome condition, when manufacturers wait so long for the protection of a patent before undertaking to make a good thing on a commercial scale. Nevertheless, one must accept the fact, and the cooker has not been taken up by any manufacturer. Warned by this lesson, I applied for a patent on my first "Aladdin Ovens," which were made wholly of metal, the outer oven being packed with non-heat-conducting material; but on this application I failed; this identical apparatus had been invented fifty years ago, the heat being derived from a pan of charcoal, and the patent had expired; of course, the charcoal did not meet the necessary conditions. I found, however, that the oven made wholly of metal packed with carbonate of magnesia or fossil meal would be very expensive; moreover, the outer metal skin wastes a great deal of heat. I then experimented with various compounds, and finally adopted the material of which these ovens are made, known as "*indurated fiber*," or paper pulp, prepared in a certain way under a patent and baked at a high heat. I applied for a patent on an oven made in this way, but the mere substitution of the pulp for the metal did not suffice to give me the patent asked for. There is therefore no patent on the construction of either of these devices. The names "Aladdin Cooker" and "Aladdin Oven" are my trade-marks, on which I may hope to hold a certain control, so that the ovens shall be made of safe material, incombustible at any degree of heat required for the work, and from which control I may possibly recover the money which I have spent on my experiments; if I do not, it will be my contribution to the public service; and if by this contribution I can do away with even a small part of the waste of good food material and with a small part of the indigestion caused by bad cooking, I shall consider myself fully compensated.

Under such conditions I may perhaps venture upon the ordinary method of citing the testimony of some of the few persons who have bought these ovens and who have made use of them. I will first give a copy of a letter from an elderly lady who visited my office with her daughter; the latter was very skeptical as to success in working my apparatus; the oven was, however, bought, and has been in use during the past summer; her testimony in regard to it is as follows:

> I am glad to tell you that I like the Aladdin oven very much indeed. My dinners for the last three months have been cooked in it with success and economy, and the kitchen never overheated. It saves material, fuel, and labor, as well as heat. It is an immense comfort as well as economy. It bakes bread and cake nicely, and we have only used coal for laundry purposes. I wish it could be produced at a cheaper rate, though I would not lose mine for twice its price.

Another certificate I may venture to give from another lady who has tried the apparatus, as follows:

> 1. In respect to economy in the use of material for food: All remnants of food can be served again without drying or losing any of the fresh flavor. With any skill, therefore, "made dishes" can be produced until the first material is used up.
>
> 2. In respect to comfort of the kitchen: It goes without saying that a room in which only a lamp is burning is cooler than one with a fire in an iron stove.
>
> 3. The cook says it is much less work; but I find they sometimes from force of habit throw the fuel into the stove and cook there rather than take the trouble to use the oven.
>
> Lastly, general conclusions: It is of inestimable value in warm weather, and saves two hods of coal a day when it is used half the day. For an apartment-house or in small kitchens it will be a great boon. With an intelligent, care-loving woman it will go much further and do better work, of course, than with the ordinary cook, though it is so simple that any one can use it.

In a third letter, the testimony is as follows:

> My general conclusions in regard to health and appetizing conditions are: Bread from the oven is much more wholesome than from the range, because of the slow, even, and thorough baking. Meats are more wholesome, because the juices are entirely preserved and the fats not overdone. The greatest advantage, perhaps, is the possibility of so regulating the temperature as to preserve fine and delicate flavors at the same time that the most wholesome results are secured.

Finally, I am permitted to give the following extract from a note from Mrs. Ellen H. Richards, whose excellent work in industrial and household chemistry is doubtless well known to you.

I submitted the early types of my oven to an investigation which was conducted under her direction by Miss Marion Talbot, whose thoroughly scientific report upon the diffusion of heat and other matters encouraged me to go on, and was wholly consistent with my own experiments and with all the evidence which I have since obtained. This latter report is too long for inclusion in the present address. Mrs. Richards's present statement is as follows:

> It seems to me that the mission of the Oven and Cooker is in the ideal life of the twentieth century, as shown by Bellamy. That is, when the people of the middle classes, as we know them now, shall pay attention to the question of food,

and when the present kitchen and cook shall be abolished; when in each section we can buy a chicken ready dressed for the oven, a fish all washed and stuffed; when we can get bread and pastry such as we like; in short, when we have places like the Women's Exchange on Boylston Street, in each ward or village—then we shall use the Aladdin Oven, to dispense with kitchen and cook, but until then it will come into use only as an accessory, and especially in summer.

Unskilled hands can get much better work out of it than out of an ordinary range, chiefly because it can not be overheated, and things can not be burned to a crisp.

Our people need to learn what is to them a new art, the delicate flavoring which is brought out only by time—that is, by *slow* cooking.

When a stew deliciously flavored is to people better than *crisp* beef, then the oven will go; but the majority of our people are still barbarians in taste, and it will not do to claim too much.

I am sure that the conditions of slow cooking are very favorable to ease of digestion, and that the digestibility of many things is very much increased.

I am sure that economy lies in the use of material which is much less expensive, but here again we must learn to like the result.

In summer the saving of fuel is very great; in winter most people need the fire—often the kitchen is the only fire.

Educated housekeepers with their own hands must work it up. Servants will not learn anything new unless working with the mistress.

I believe the idea is destined to give a much-needed relief to multitudes of overworked women, just as soon as they can be convinced of the possibility of relief.

I may venture to subscribe myself, especially in this presence, by the use of the same words which I once adopted as a motto in my treatise on the "Missing Science of Cooking." I am—

COCTOR NON DOCTOR.

OLD AND NEW METHODS IN ZOÖLOGY.

By M. H. de LACAZE DUTHIERS.*

PERMIT me to begin my address by a reminiscence of the origin of this Association, which has haunted me from the moment when you did me the honor to make me your president. It was in July, 1871, when, as we were leaving the Academy of Sciences, Wurtz, taking me by the arm, in his friendly way, said: "Come to my house to-morrow evening; I wish to talk with a few of my friends concerning a scheme which I should be very glad to see carried out." MM. Delaunay, Claude Bernard, Decaisne, and I met at Wurtz's house in the rue Saint-Guillaume on Tuesday evening, and held what we may call the first meeting of the Association. As the last survivor of the company I can not refrain from recalling that intimate interview at which our Associa-

* From the presidential address at the French Association for the Advancement of Science.

tion was born. I can still see Wurtz, with captivating animation and almost feverish activity, pacing the floor with precipitate steps and picturing to us what he thought our society ought to be—and what it has become. He pointed out the priceless advantage to be derived from these meetings, to be held in all parts of France. "We shall," he said, "seek out modest local students living far from the center to meet us and make known the results of their investigations; we shall draw the most timid of them into the scientific current, and shall thus be able to exalt our beloved country in the eyes of the scientific world." Now, the only witness of that first and modest meeting, I believe that I am the interpreter of the feeling of you all in paying one more tribute to the memory of these our first and illustrious co-laborers.

In addressing you I purpose to inquire what zoölogy was, what it is with some, and what it should be. The science of animals of a hundred years ago and that of to-day resemble each other but little. Comparing them and seeking the cause of the great differences, we recognize a few leading facts which I have selected, and of which I will speak. In the former time, when so many reforms were in preparation, and when excited minds were looking for other objects on which to utilize their activity than our sciences, always calm and independent of revolutions as they ought also to be of politics, natural history held b a small place in men's thoughts. In 1789 Linnæus and Buff had only recently died, and their names were still radiant the splendor of their living brilliancy; they dominated as lute masters, and summarized in themselves all of zoölogy in their minds and works they resembled each other but Linnæus, precise, methodical, a classifier first of all, brough and clearness into the minutest details of the things of and, as he proposed a concise and easy language, his infl came so preponderant that Haller complained of his ty the reform of the scientific language which Linnæus imposed itself with such force, it was because it ans of the needs of the moment. The simplicity, facilit cially the opportuneness of his nomenclature were th great success; and it should be added that its value that we have not yet sensibly departed from the rul was founded.

The opposite of Linnæus, Buffon took plea drawn descriptions and pictures; and, when he tr considerations, he animated them with a powe A profound thinker, regarding science from an view, he engrosses and subjects us. Who amon ollect the enthusiasm with which he has read s in the "Epochs of Nature"? By his reason quences of the observations which he interpreted, Buffon sought rather to foresee what should be or ought to be, than to fix what he ascertained. He was thus often in advance of his time, and the elevated considerations to which he gave himself were within the grasp of only a small number. Linnæus, on the contrary, described, simply and clearly, what was. With such qualities these two men would often be far from agreeing; and we might apply to them the distinction, which had not yet been expressed, between the school of facts and the school of reasoning. While Linnæus and Buffon thus summarized in themselves all of zoölogy, although from different points of view, their labors lacked a basis the imperious need of which was universally felt. It was already beginning to be understood that the study of the habits, geographical origin, and external characteristics of animals was not enough. At that moment Cuvier appeared. The reform which he introduced in zoölogy was very important, and his work, on the "Animal Kingdom distributed according to its Organization," produced a momentous impression. His great fame, like that of Linnæus, is due to the fact that the modification he made in zoölogical studies corresponded to a certain want, and was a necessary reform that came at the time when it was most needed. Zoölogists of the classifying kind, who occupy themselves only with the externals of animals, have been compared to librarians who arrange their libraries according to the backs or covers of the books, without regard to what is within them. It was Cuvier's great merit that he saw clearly that to reach a truer knowledge of things we must not only be acquainted with the names and external features, but with the internal characteristics as well. To that end he introduced the anatomical idea into the history of animals. In doing it he rendered the greatest service to zoölogy; and to this, too, must be attributed his great success, which was equaled only by that of Linnæus, and also the great reputation in which French zoölogy shone at the beginning of the century. To-day, even those zoölogists who criticise Cuvier the most, nevertheless follow his precepts. We can not apply the same standards of criticism to his work that we would insist upon in judging a work of to-day. To make an equitable estimate, we should put ourselves back to his time, and take account of the gaps in the knowledge of that period, and of the insufficiency of the means which observers could control. It will soon have been a hundred years since Cuvier's work was performed. In that time a great many discoveries have been made, and many conquests have been achieved to cast a new light on questions which were insoluble then.

Zoölogy remained for a long time at the point to which Cuvier led it; and we have to come to the middle of our century to see new [illegible] and bringing about great modifications in the

direction of studies or in some of the branches of the biological sciences. I purpose to supply only a few examples of them. I recollect that in 1855, when I was a professor at Lille, Mr. Huxley wrote to me that "we in England are all stirred up and much perplexed by the discoveries of M. Boucher de Perthes." The reference is, of course, to the interest that was aroused about the cut flints of Saint-Acheul and the famous jaw-bone of Moulin-Quignon. English men of science and geologists came to Amiens, lively discussions took place, a committee of Frenchmen and foreigners was formed and proceeded to the spot to make official investigations. Some fraud and incredulity were mingled in the affair. A workman confessed to me, for a money consideration and a promise of silence, that he had himself fabricated one of the two specimens which I procured, and that it had not lain long enough in the bed to acquire the patina of the other. The point I desire to emphasize is, that the real thing that was discovered then, especially after the visit of the British investigators, was the books, the researches, and the new ideas of M. Boucher de Perthes, which had till then passed unnoticed. The beginning of the prehistoric studies, which have since attained so considerable development, may be dated from
this time. Since the discoveries of Boucher de Perthes at Saint-
Acheul, and those of Lartet and Christy in Périgord, a part of th
history of man has been completely transformed; and geology,
far as concerns the most modern formations, has been subject
to the salutary influence of the new knowledge. What has bec
of the superannuated ideas that conceived fossil man imposs
What new problems, full of interest, have been presented
the remains were found in Périgord and other places of
that no longer live where their bones are lying! How m
teresting questions have resulted from the simple discov
reindeer-horn in a grotto of Eyzies; and what a long
have gone over since then! Is it strange that the n
explorers has become great, and that liberal and ofte
cent encouragement is given them? It would be u
this connection not to repeat the acknowledgment o
tions to one of our members—M. Girard, of Lyon—
queathed to our Association one hundred and seven
sand francs to be applied exclusively to researches
anthropology; the proceeds of which your comm
use this year for the first time.

The lively emotion produced by the discoveri
de Perthes had begun to subside, and research
everywhere, when Darwin's first studies appear
These dates must always be memorable in the
science, for they mark an epoch from wh
entered upon a new course. The learned

revolted when Darwin's book appeared. Then enthusiasm, with all its exaggerations, succeeded the first astonishment; and in a little while, a reaction taking place, innumerable investigations were begun with an activity and a curiosity which the previously received ideas were no longer capable of determining. In the first spasm of enthusiasm the great naturalist's theory was called Darwinism; at a later period, dealing less in details and generalizing more, it was called Transformism.

It must be recognized that whatever measure of confidence we put in transformism, whether we accept it in its whole extent and with all its consequences, exaggerate it, modify it, accept it with amendment, or reject it, no one can doubt that it has provoked a truly extraordinary scientific movement. Both partisans and detractors, in seeking for proofs in support of their opinion, whether demanding its secrets from embryogeny, or digging into the strata of the earth in order to interpret the remains of organized beings which they inclose; all, whatever may have been their method, ideas, opinions, or even hostility, have contributed greatly to the progress of zoölogy. Thus we are far from the period of Linnæus, when the external character was everything; and from the period of Cuvier, when the anatomical idea and the study of the exterior were the only guides of the classifier. Now we investigate the connections of beings by going back from the existing to the primitive forms, or *vice versa*. We try to explain the varied forms under our eyes by the aid of the laws so happily formulated by Darwin. Evolution is encountered everywhere. Whether one be a transformist or not, he must bow and acknowledge the force of the tremendous bound which the impulse given by Darwin has caused.

There are, however, as Claparède has said, "terrible children" of transformism who are more anxious to make a noise around their name than to discover the truth. We must prudently distinguish from them the conscientious students who seek long, scrupulously, and painfully for precise facts in order to deduce from them consequences that will support their theories. These surely advance science, while the others often compromise it. The one thing to oppose to exaggeration, assumption, and enthusiasm is experiment. It is as mandatory to-day as in the preceding period were the reforms which I have mentioned.

While Darwin had an immense and legitimate success, the ideas of Lamarck, who more than half a century before him taught and published the same views on the mutability of species, were long forgotten. Our illustrious compatriot has been treated rather unjustly and severely. There are whole pages in the works of Lamarck containing the theory of transformation completely
to which Darwin has added nothing except to confirm

them. The minds of zoölogists were not prepared in his time to receive his ideas, and he had not the happy faculty of hitting upon that clear and precise method of statement that imposes itself and makes itself accepted by all. For a reformer to secure a following, his idea should be defined with dazzling clearness and precision, and achieve mastery by virtue of its seductive force. Darwin's exposition of the universal and constant struggle for existence, ending in the selection and survival of the victor, was so true and clear as to lead all readers into accord with it. Cuvier, they said, could reconstruct the whole of an extinct animal from a single bone. The thought spoke to the imagination of the masses; and when he laid down the principle that in an organism, as in an equation, the known terms may be made to give an unknown one, he commanded the admiration of a whole generation. Linnæus, who at a stroke reached the reform science was aspiring after, to rid itself of nonsense in nomenclature, and who found names to fit the occasion, became the tyrant of natural history. It was not possible for Lamarck to realize a similar success; and a comparison of his arguments with those which Darwin brings in support of the doctrine of changes in the forms of animals, and a reference to the epoch in which he wrote, will show why his ideas had to wait for the revelations of the English naturalist before they could be recovered from oblivion.

In view of the surprising discoveries to which the continuous study of the evolution of the lower animals has led, and of the direction of zoölogy under the influence of transformism into new ways, it is impossible not to recognize that experiment alone fulfills the requirements of the moment. It is only through experiment that the great questions of natural philosophy can be answered; that the discussions raised by clashing convictions, hazardous assertions, so-called philosophical doctrines, and venturesome syntheses too often lacking substantial bases, can be justly appreciated or solidly established.

The citation of a few instances will illustrate this assertion. Every one has noticed the gall-nuts on oak-trees, excrescent tumors produced by parasitical insects—the *Cynips*—which lay their eggs in the mother plant by the aid of a gimlet-shaped ovipositor. The young insect finds within this swelling all that it needs to support life, and quietly in it reaches complete development; and it can easily be caught as it issues from its prison. Entomologists have catalogued a large number of species and genera belonging to the family. In doing thus, they have followed pure and descriptive zoölogy, as it was in the times of Linnæus and Cuvier. Now, it has been found, after watching the evolution of these parasites, that all the genera and species have to be revised. Thus, for example, we find on the superficial roots of an oak-tree galls of varied colors and sizes, the insects issuing from which are wingless. When the trial is made, they will be found incapable of reproducing the warts they came from; they are, besides, all females. Again, we may see, in the spring, the ends of the limbs of the same oak bearing greenish-red tumors, which naturalists have long called oak-apples. They are also galls from which *Cynips* issue; these too, like the others, are incapable of reproducing the swellings from which they came; but they have wings, and are both male and female. Here, then, are beings totally different, if we study them separately as they come out from their nests. Now let us follow the experimenter, first observing that the insect of the root has been called *Biorhiza*, and that of the apple *Teras*. The *Biorhizas* escape from the roots on which they are hatched, and raise themselves up slowly and painfully, having no wings, to the ends of the branches of the tree. There they lay unfertilized eggs, and cause, by piercing the twigs, the oak-apples from which the *Teras* issue. On the other side, the *Teras*, escaping from their apple, copulate, and the fertilized female descends to deposit her eggs in the roots. The *Biorhizas*, therefore, are hatched from the eggs of the *Teras*, and the *Teras* from the eggs of the *Biorhizas*. Here, then, are two genera wholly distinct in habits, organization, and external characters, which are nevertheless derived each from the other, and which zoölogically ought to form only one. How could M. Adler have discovered these facts, except by experiment? When we remark that the *Cynips* are relatively high in the animal scale, we are justified in believing that a very great number of similar surprising facts may yet be found among lower forms.

I can not refrain from relating another life-history which is almost a romance. There is a hard sandstone in Provence, interspersed with friable strata, in which burrowing insects construct their chambers. A kind of bee, the *Anthophorus*, makes nests there and fills them with honey, on which it leaves its egg to float; then, finally, plasters up its chamber. Instead of *Anthophores*, entirely different insects come out from these nests—*Sitaris*, belonging to a group very remote from the bees. Let us see how they manage to substitute themselves for the legitimate proprietor of the nest. In the autumn the impregnated female of the *Sitaris* deposits her eggs in front of the sealed galleries of the *Anthophorus*. The young are hatched from these eggs, and lie in front of the closed doors, and thus remain in a mass, mingled with the dust and rubbish of the place, through the winter. In the spring, such of the bees as have reached their term come out from their prison. These earliest insects are all males; but, though preco-
ched, they are still tender to the changes of the
f frozen and torpid in the dust along with

the young of the *Sitaris*. The time has come for the last to begin to act. They have been called *Triongulins* by Léon Dufour, from the claws with which they are armed, and by which they attach themselves to the bodies of the *Anthophores* waiting for the next stage in the conditions that favor their development. With fine weather the female *Anthophores* come out and carry on their work of burrowing and storing up honey till the time of fecundation arrives. Then the *Triongulin* changes its quarters from the body of the male to that of the female, where it remains on the watch for the laying of the egg, when it transfers itself to that, and with it enters the honey-chamber. With it it is shut up when the *Anthophorus* closes the door of the chamber for another season. The *Triongulin* will not eat the honey, for it is sure death to it by drowning if it touches it. It floats on the egg and feeds upon it; when it has used up its ration, it changes its shape, as well as its habits and taste. It is as eager now for the honey as it was to keep away from it, and grows upon it till it goes through another change and becomes the *Sitaris* which we observe coming out from the chambers of the *Anthophorus*. Three years of assiduous studies and investigation were required to obtain this curious life-history. Contrast now the results obtained by Léon Dufour, an entomologist and naturalist of the school of Cuvier, with those which M. Fabre has reached by experiment.

I could also show you examples of an excessive socialism in societies of animals, even passing the limits of what has been conceived for men; comprising individuals whose parts are assigned with the greatest precision, some working to feed the collectivity, eating and digesting for all, others possessing the single function of reproduction of the species; and still others serving as beasts of burden for the rest; and looking a little further, we might occasionally discover idlers at rest while their fellows are working to feed them. Take the lobster which we fish from among the rocks and on the sea-coast. In the earlier part of its life, it swims at large on the surface of the fresh water. Its plump and fleshy body, so sought for as a food, is represented then by a broad and extremely thin plate, so peculiar that the zoölogists of the old schools made it not only a genus, but one of the types of a group very remote from its fellows. What would be the difference between these zoölogists and one who should regard the child and the adult of a savage man seen for the first time on some unknown island as forming two genera? Is it not evident that in the times of Linnæus and Cuvier, when they examined animals at only one moment of their existence, naturalists could not follow the filiation of facts which evolution alone reveals to us? The discovery of the *Triongulin* and the *Biorhiza*, made when species were defined only according to characteristics falling under the senses, the surprising transformations of which had not been shown us by their evolution, could not possibly have informed us of the true significance of those beings.

I know very well that the quality of an experimental science which I claim for zoölogy is not accorded to us by all students. Those who withhold this recognition are specialists who judge of our science by what they learned of it when they were pursuing their general studies, and when it consisted chiefly of learning names and registering characteristics. They still think it a science of words and memorizing. But we are happily able to reflect that while they have followed and pushed on the science in which they have become masters, they have concerned themselves but little with the advance of the other branches which they have not cultivated; and their present judgment is based on the condition of the science a half-century ago. I think it can be established without contradiction that there is not a zoölogist of the present day, unless he be over-rash or ambitious to enjoy the discovery of a new species, who will venture to affirm that he is acquainted with any being before he has followed its evolution. To follow the evolution, experiments must be instituted, and that constitutes experimental zoölogy. Because our science is now in a critical condition, it is most positively affirmed by the partisans of the transformist theories that it should modify its methods of investigation, and besides registering species should submit unreservedly to experimental control. Such is the conclusion which we logically reach, and which imposes itself upon us to-day.—*Translated and abridged for the Popular Science Monthly from the Revue Scientifique.*

THE DECADENCE OF FARMING.

By JOEL BENTON.

SOME years ago the editor of a prominent journal sent me a slip containing a column and a half of advertisements of farms for sale, cut from a Boston daily paper. The farms offered were located in New England, where the supposed benign effect of the national Government's attempt to "diversify industry," so that farming need not be overdone, has had its supreme chance. These farms were not poor or worn out. They were in the midst of our best social culture, as developed by our most intelligent rural communities. Upon them were improvements and, in the main, good buildings. Railroads ran over or near every one of them; large factories and populous towns were near, to buy their prod[illegible] schools and churches were visible, almost from their [illegible] ays; beauty was in the landscape, and health in the very air. Whatever the best civilization has to offer, outside of great cities or large towns, was accessible to the homes they represented. If anywhere on the planet human beings could be happy and prosperous, in beautiful homes, it should have been there.

But the farms were for sale, nevertheless; and, though this was fifteen years and more ago, some of them are for sale still. The column and a half of advertisements was only a sample of a hundred other columns of advertisements of a similar sort published in other New England papers; and the offers to sell still go on. The clipping sent to me, as symptomatic of a great movement, came from the office of a famous protectionist daily, and was sent in order that I might make some appropriate comment upon the situation, or give some advice which should be apt or remedial in relation to it.

This was done at a period, however, when there was no question of taxation or political economy uppermost in the public mind. No suspicion, even, was entertained that legislation of any sort was involved in the problem presented, or that any other than a hortative appeal to boys to stick to the farm, or some suggestion as to better modes of farming, was needed.

It is now twenty years, at least, that farming has been going rapidly downward. Farms bought in the war era have been selling almost everywhere in the East for from *one half* to *one third* of their cost. Farms in New England, and some in the Middle States, are frequently sold for less than the buildings cost which are upon them. This is really no exaggeration. Sales of this sort, and where the depreciation in value has wiped out the owner's equity in them, have been for years a matter of notorious knowledge in almost every Eastern community. Within a year, in a healthy and fertile county not sixty miles from New York city, a farm having on it two mortgages—a first mortgage of three thousand dollars and a second mortgage of two thousand—was sold, under foreclosure, for the sum represented by the first mortgage only. The holder of the second one did not think it worth while to be present, or to have a representative present, at the sale, to bid the single dollar which would have saved or made a show of saving his investment.

Very recently the New York State assessors have issued a report containing some results of what they have discovered so far as they have gone, in respect to the assessed valuations of farm lands in the various counties. And this is their story: "In fourteen counties visited they found that farming lands had depreciated in value, while city property had increased in value." State Assessor Wood is of the opinion that "in a few decades there will be few or none but tenant farmers in this State. Year by year the value of farm lands depreciates." There is not the slightest reason to believe that there is a county in this State of which a better report can be made. The fourteen examined may well stand for all.

Following closely on this report for New York comes the report of the Bureau of Labor Statistics for Illinois, in reference to farm-mortgage indebtedness. This gives a summary of this indebtedness at the following periods, viz., in 1870, 1880, and 1887; and evidence is also given as to the actual value of farming lands in the State. By leaving out town and city lots, and the suburban district of Chicago, the purely agricultural part of this debt is seen. And it is given as follows:

Year.	Debt.
1870	$95,721,003
1880	103,525,237
1887	123,733,098

The report tells its own story; for farms are a constant quantity and do not increase. It is only the wave of debt that increases over them. As this report separates, with such accuracy as it can command, "mortgages representing deferred payments of purchase money from loans," the deduction of the commissioners is, that "the mortgage indebtedness of farmers for borrowed money has increased twenty-three per cent since 1880 in Illinois, and that this is more than *twice the increase* in the value of the farm lands. An increase in land values is reported in twenty-five counties, a decrease in twenty counties, while in sixteen counties the values have remained unchanged."

This is far from a pleasant showing for a State so naturally good as Illinois, and one which was so recently a new and almost a frontier Commonwealth. But you may go farther West and find figures of the same solemn sort. In the Western States the farm mortgages amount to *three billion four hundred and twenty-two million dollars.* This is equivalent to a debt of two hundred dollars *per capita* for each person, or one thousand dollars to each head of a family. The interest which these mortgages pay runs from seven to nine per cent, while the profit on the farm capital, to put it large, is only from four to five per cent.

But, take up any newspaper or magazine, and read its advertising columns in respect to loans. What are they which are most popular and extensively advertised? Why, they are "farm investment loans." "Sixteen years' experience without loss of a dollar." And the interest is delivered at your door almost. These siphons are now extending far beyond the Mississippi and Missouri, on the virgin soil of the continent. For a while they can be borne there, where the capitalization in a farm is either slight or nothing, and where the money borrowed is mainly for buildings

mprovements. But it can not be long, without a chang
rietors, the original ones dropping their title, and giving
struggle to other lists of unfortunates.

There is no doubt but that the investments in these vam
rtgages are good—that is, good for those who loan the m
l good also for those roving or stationary agents who
ir commissions out of them, and who scour every E
wn where money is to be had to put into this form of se
am not blaming these negotiators. The money must b
owed, and somebody must furnish it. But is it not pitif
he one business in this world which seems nearest to man's
ive nature, without which no other could exist, and int
the moralist and the well-wisher of his species is ever
advise young men to go, should be the selected prey of
destructive and cruel legislation that can be invented by
of man?

All over the statute-book, if there is a law made ha
effect at all upon the farmer, it is with an almost mali
tainty—one might think, if he judged by its effects-
operate against him. Is it a half-holiday, or several w
that are enacted? The operation of them is not a hel
a draught against, the farmer. His cows and his crops,
itself, to whose laws he is more than anybody else
will not and can not accept their supposed advantage.
must still go on; and these are only new stumbling-b
way, which leave him shorn of his hired help, to pur
without the customary assistance. If an eight-hour
ed, its maleficence, not its advantage, falls on him.
hour and the harvest will not be postponed in obe
legislature. So far as it makes the day's labor brie
it extends his own labor from twelve hours to fourt

Notice, too, how every tax system now upper
heavy end of its incidence on the farmer. In th
and township allotment of fiscal burdens the ta
falls upon what can be seen and discovered with
But it never fails to discover the farmer. His
not be hidden or sworn away; while his neigh
sonal holdings, can cunningly suspend his own
and sometimes by an artful change or confusion
as to add his tax, too, to the tax of the beridden
But worse than all this is his relation to

But worse than all this is his relation to
system, which exploits away his hard-earne
percentage, almost invisibly, and then adds
successfully persuading him that it exists for
tage. He pays for a paper, as likely as not, whi
been telling him for a generation or more, th

tem which prevents him from buying forty-five hundred articles as cheaply as he might, and compels him to sell his own products, minute in number, at the lowest price which ingenious legal artifice can dictate, is a measure for his particular benefit. If he has read a paper which denies this, the doctrine is so new to this generation that he has not yet mastered it; and he is apt to treat it with conservative inattention, or as a delusive suggestion, an investment in which must be set down for the present as one to be treated with as much caution as he would exercise in accepting an unheard-of and revolutionary scheme for working his farm.

The siren charm with which the word "protection" asphyxiates him has only casually, as yet, lost for him its sorcery. He is apt to have confidence in some regular order of things, such as the seasons, the sunrise, and the sunset; and to him "protection" is, and has been, through long experience, as stable a factor in affairs as the precession of the equinoxes or the laws of the solar system.

But, if he is ever to rescue his business and make it decently profitable, he must awaken from this long swoon. He must see and know that taxation of this sort is death to him; and is fast making it impossible for an intelligent American to live and raise a family with the decent comforts of life on the best farm in the New England and Middle States. Very rapidly, in New England, the farms are passing into the hands of the foreigner, or distinctly peasant element, a class which reduces the necessities of life to the simplest scale, and which is able to do farming within the family, and so can eliminate the costly feature of hired labor. The question has been asked for years, "How shall we keep our boys on the farm?" But it has never been answered successfully, and never can be. We ought to be profoundly thankful, considering what the farm now is as a business, that we can not keep them there. It is the best possible evidence attainable of the bright wit and level-headedness of the boys that they wish to work where gain is assured at the end of their toil.

I may be told, very likely, that I have skipped one feature of the tariff, the one on wool, which was devised especially for the farmer's profit. But it was not; and, if it had been, it has hurt him instead of helping him. It was devised by men who are either commercial men, or whose predominant interest is commercial rather than agricultural. These men constitute what is known as the Wool-Growers' Association. I think its important factor is made up of middle-men, or salesmen who traffic in the wool product. But, be that as it may, the duty on wool has simply handicapped the manufacturers of woolen fabrics; and by shutting out kinds of wool which we *can not raise here*, and which the woolen manufacturers *must* have to mix with native wools, has actually lessened the demand for native wool, with the effect to *lower its price*. Apart from this, it is a notorious fact that the price of wool does not ever bear the relation it ought to, on protection theories, to the rate of the duty. I once traveled with a wool-buyer, years ago, when a lower tariff than the present one prevailed, when he bought wool of the farmers, to speculate on, and gave one dollar a pound for it, which was the market price. Does any wool-farmer expect to get over half that now? A very intelligent farmer, on whose hundreds of acres the wool product has been a feature for sixty or seventy years—a man who holds general "protective" opinions—told me frankly that the tariff, touching wool, gave no enhancement of price. He confessed that he had got very high prices for wool under a low tariff, and very low prices under a high one.

As this wool-bribe is a menace to direct and equal laws, and is the price offered the farmers for support of legislation absolutely hostile to them, suppose we look a little further on its effects. Here are some facts for farmers to think over. Twenty-one years ago there were thirty-eight million sheep in this country east of the Mississippi River. We have "protected" them all this time, and there ought fairly to be now, under a decent ratio of growth, at least fifty million. Are there this number? On the contrary, there are now only eighteen million one hundred thousand. And they and the wool itself have greatly declined in price. It is said that, since 1875, there has been an increase in the number of sheep of about thirty per cent. But this is accounted for by the extension of farms in our new Territories. The large flocks there are chiefly owned by aliens or absentees, and even these flocks, with their peculiar local advantages, are declining in value. Not a fraction of this increase in number can be due to the tariff, and no benefit comes from it to the growers of wool in the older States.

To supplement these facts properly, read the following answers to questions propounded by the "Massachusetts United Questions Club," given by ex-Congressman John E. Russell:

> Question 4 is as follows: "Does the tax on foreign wool imported put the price of that up so much that, although the price of American wool is lower than it ever was before, yet our domestic woolen manufacturers are put at a great disadvantage with foreign manufacturers, so that we can not make goods at so low a cost or of so good a quality, except such kinds of goods as can be made wholly of domestic wool?" Mr. Russell replies that the specific duties on woolen cloths and flannels put the American manufacturer of fine goods at a sad disadvantage, confining him to the home market, and that the high price he is compelled to charge for goods narrows and restricts his market. Mr. Russell continues: "Makers of the fine flannels that are sold in competition with the best English and French goods import South American wool that has been sent to France and there cleansed of dirt and burs, and scoured. The duty on this wool is thirty cents a pound. There is no wool raised in this country that will answer the same pur-

> pose. It is the result of a soil and climate different from ours. It goes to France because, though France is a protected country, they do not think it economy to tax the raw material of manufacturing, and they consider it wise to so draw the line of protection as to preserve commerce with nations producing raw material. They exchange goods for wool, they make the freights, commissions, and profits of shipping, and we pay them for manipulation of the wool."
>
> "Question 5.—If the effect of the tax on foreign wool has been to put down the price of domestic wool and to put up the cost of woolen goods, who gets any benefit from it? Is it the farmer, who gets less for his wool and pays more for his clothing?"
>
> "Answer.—The benefit of this tax accrues to the politicians and to other enormously protected interests. The tariff on wool is the key-stone of the wide arch of protection, because it binds the farmer to the support of the whole system. Without his support the tariff would be reduced to a tax that would raise only what is required by the Government economically administered, with incidental protection. How the farmer is deceived may be further explained by a calculation of what he gets even if he makes all that is promised him. The duty upon unwashed wool that comes in competition with ours is ten cents a pound, the average number of sheep in a flock upon the older Western farms is not over thirty, and the average product of wool on such a farm would be about one hundred and eighty pounds. If the duty increased the price of this wool ten cents a pound, it would be but eighteen dollars to each flock, or less than the enhanced cost of the clothes of his family. It gives him nothing to pay the increased cost of lumber, salt, tin, crockery, implements, fence-wire, etc. The fact is, that his protection fails to protect, and he gets nothing but the privilege of carrying the load. He is a victim of those who cut straps out of the hides of the poor to make stirrup-leathers for the rich."
>
> The next question of importance is number 9. It is as follows: "Is not the farmer misled when, under pretense of protection to wool, the price of his wool is reduced and the export of his wheat and cotton is partly stopped, because by way of a tax on foreign wool we prevent in part an exchange of wheat, cotton, and flour for wool? Answer: 'Misled' is a weak term to use under the circumstances. We might say he is in the same position as the man who votes for high taxes to keep up his wages!"

If there is any farmer in the land who can read these undeniable facts, and, after doing so, is still willing the "wool" shall be "pulled over his eyes," he, at least, deserves little pity for his fate. Sheep ought really to be a profit to the farmer, as they are an important factor in soil enrichment. They ought not to be unprofitable if they grew hair in place of wool. But our law-makers have doomed them. The only "protection" they ever were in need of is protection from dogs and tariff-mongers.

There is really no probability that we can ever have a "farm-protecting" tariff, for obvious reasons. One is, the farmers are too numerous to organize efficiently. They lack the massed capital and commercial skill necessary to maintain a lobby at Washington. They are too vast and minutely divided a body to be thrown into any efficient cohesion. To move Congress and compel politicians, you want just the sort of conspiracy that exists and is upheld by the tariff barons and beneficiaries—a comparatively few very wealthy corporations, each one "log-rolling" with the other for mutual benefits. By their employment of large bodies of workmen, and their power to contribute money and to bulldoze morally through the "pay-envelope," congressional districts, States, and the nation are in their clutch.

Of course, the farmer vote is great enough to have its way, but it can not apply itself with the force and ease of a well-regulated machine, as its almost feudal masters can theirs. Our farmers lack also, as I have already said, the clear perception that they and their interests are exploited. The system which robs them, under cover of law, large numbers of them still believe is for their own benefit.

It is a matter for amazement, though, that some leaders among them do not, at least, plead through their granges and societies, for *direct* protection, since they are so sure the complex taxation of themselves tends to their prosperity, by some indirect *hocus pocus* which nobody can explain. If protection is good for agriculture, it would certainly help it more to put it in the line of *direct* benefit, and let other industries, so long pampered, have for a change the *indirect* blessings of the tariff for a term of years.

As the farmers are by far the most numerous single part of our population, and represent well toward one *third* of the people in numbers, why not give to them *directly*, lavish bounties from the national treasury? Let an act, for instance, be passed to give them from fifty to one hundred and fifty per cent more for all they raise than they now receive. This would somewhere near double their income. With this great enlargement of their means they could pay more for labor, and they could buy two or three times as large a quantity of manufactured goods. Of course, "could" invariably means "would" in the protectionist's dictionary; and so we should see a tremendous impetus given to all other industries, and to manufactures particularly, by the very greatly increased purchases of the farmers and their doubly paid help. As it has been for two or more generations, "the few" have been protected on purpose to help "the many" by the tremendous overflow which the benevolence of "the few" precipitates. But just think how much more overflow would be sure to run from "the many" to "the few" than is possible in the other direction!

Could there be any finer or fairer scheme than this? Having lived in the moonlight of protection so long, is it not the farmer's turn now to have its sunlight? And, inasmuch as the manufacturers and protected interests say that this moonlight, or indirect incidence of their tax system, is a great good to the farmer, it will, of course, be of great good to the manufacturer. And there will be vastly more of it, since large bodies reflect immensely more to all ones than small ones do to large ones. Or are the protected terests really afraid to take their own prescription? We suspect ey would be, and, in fact, could not be hired to take it.

But it is the impending truth—which will some day, and I think ery soon, filter into the farmer's mind—that alone can save him. When he sees that he, and he most of all, is bled for others, and or their private gain, he will cease to believe in enforced phlebotomy. When he finds out that the word "protective," so far as he is concerned, is an abominable misnomer, and should be translated "destructive," there will be heard a voice from the farms that will give the system so long delusively described its death-blow. Years ago the farmer's boy, when he went to school, was taught that the business of the United States consisted of "agriculture, manufactures, and commerce." It has long since ceased to be an equal tri-division. Agriculture and commerce, as they once were, are things of the past. The one has been made unprofitable beyond description; the other is now impossible, except in a reduced way, under an alien flag. Ship-building is "protected" to death, and the American money that goes toward having it done abroad simply builds ships that, in case of a war, can be turned against our own shores and our depleted navy. But we have—as trophies of our absurd Chinese system—manufactures (none too flourishing, if the men engaged in them know) and a "protective" tariff.

The long endurance of the superstition on which "protection" is based has had two bulwarks—the necessity for revenues extraordinary, and the power of money, contributed by directly interested parties. An economically administered government should break down the first, and the force of facts the second.

As we hold in derision now the discovery of the philosopher's stone and perpetual motion, so future generations will look upon this fetich of our time, and not without unspeakable amazement. They will see a generation here and now that is trying to lift itself over the fence by standing in a corn-basket and pulling upward on the handles. The wonder will not be so much that they tried, as it will be that for so long a time they supposed they were successfully performing this impossible feat.

The history of the genus *Platanus*, which includes the Oriental plane-tree and our sycamore, has been traced by Lester F. Ward back to the Tertiary period, when there were at least twenty species, mostly American or arctic. The genus and the entire type to which it belongs seem therefore to have been American; and its numerous and strange archaic forms "not only formed the umbrageous forests on the shores of the great inland Laramie Sea where the Rocky Mountains now stand, but also those of the ocean at a time when it still pushed its arms northward across what are now the great plains of Texas, Colorado, and Wyoming."

SENSITIVE FLAMES AND SOUND-SHADOWS.

BY W. LE CONTE STEVENS,
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THE conception that sound is due to wave-motion in an elastic material medium was first distinctly expressed in the sixteenth century by Lord Bacon. He distinguished between local motion in a medium and the propagation of this motion through it, referring to the transmission of sound through both air and water by way of illustration. For measuring the velocity of sound in air he proposed a plan which has been repeatedly applied since his time, that of firing a cannon and noting the interval between the flash and the report as heard at a measured distance.

It is impossible now to determine how far these observations may have been original with Bacon, or to what extent they may have expressed the current knowledge of his time. They were clearly apprehended by Galileo, who discovered the law of simple harmonic motion and made the first well-authenticated experiments on the relation between vibration frequency and musical pitch. But it is to Sir Isaac Newton that we must give the credit of first applying the wave theory rigorously to the phenomena of sound. Assuming this theory, he showed the possibility of calculating what ought to be the velocity of propagation through any medium of known elasticity. He deduced a formula which has been found applicable to most media. In the case of atmospheric air it failed, but because it required a correction dependent on certain laws of heat which had not then become known. The correction was made by Laplace, and the formula, as thus completed, is now found to be applicable to all known gases. This was only one of the many important principles established on a mathematical basis in the "Principia," and published in 1687.

Even before this date, the conception that light, as well as sound, might be due to wave-motion seems to have been grasped by a few thinkers. In 1665 a book on "Light and Color" was published at Bologna, two years after the death of its author, Francesca Maria Grimaldi, a Jesuit priest and astronomer. In this he recounts some interesting experiments, which did not, it is true, lead him to the wave theory of light, but served as the basis on which this theory was subsequently established. Similar experiments were made soon afterward by Robert Hooke, the ever-jealous rival of Newton, and by Christian Huygens, their distinguished Dutch contemporary. Huygens demonstrated that, if an impulse be given to any single particle in a uniformly elastic material medium, it must be propagated thence as wave-motion equally in all directions; and that the propagation of a wave front in any given direction is the result of a multitude of interferences among the elementary waves started from the particles which are successively disturbed. Accepting this principle, the laws of reflection and refraction, whether of light or sound, follow immediately; and they were worked out with great skill by Huygens. Another consequence is, that if an obstacle be interposed in the path of a wave, its edges must serve as new centers around which secondary waves will be propagated, while the main wave continues to advance. This is familiar in the case of water-waves.

If, therefore, light be due to wave-motion, no perfect geometric shadow is possible, for the shadow must suffer encroachment from these secondary waves thus diffracted. Such phenomena were actually observed in the case of light by Grimaldi, Hooke, and Huygens, but no satisfactory explanation was then given. It is surprising that Huygens did not think of applying the theory which had been so satisfactory in its application to other optical phenomena. He had not attempted to measure the length of waves of light, and had no conception of their exceeding minuteness. If any diffraction phenomena were to be observed, the encroachment for which he naturally looked was far greater than what had been noticed as inexplicable and almost imperceptibly narrow fringes. The absence of the diffraction phenomena such as he may have expected did not cause him to abandon his wave theory, though he could not but perceive that it constituted a stumbling-block. To the mind of Newton this obstacle was insuperable; it determined his rejection of Huygens's theory.

If Newton was not the inventor of the emission theory of light, he was certainly its most ardent advocate. It came into prominence along with the wave theory, or indeed a little after this; and by means of it very satisfactory explanations could be given of most optical phenomena. Newton's reasoning, and the authority of his great name, caused its acceptance by all contemporary physicists, except Hooke, Huygens, and Euler, and by all his successors for a century. Whichever of the two theories is accepted, assumptions are involved which are open to attack and incapable of being substantiated on any antecedent grounds. Its value has to be measured alone by its consistency with observed facts. It was not until about the beginning of the present century that Dr. Thomas Young revived the long-discarded wave theory, explained the diffraction of light by its aid, and showed the incompetency of the emission theory. His views were at first generally rejected, but in time they attracted the attention of Arago and Fresnel. The latter especially entered into the investigation with enthusiasm, and completed the establishment of the wave theory upon foundations that have never since been successfully assailed. The elastic medium required for the propagation of light-waves, whether through interplanetary space or terrestrial bodies, is the universal ether, of whose existence we have no evidence except that, by assuming it and applying mathematics, the results of computation are exactly corroborated by observation and experiment. The elastic medium required for sound-waves may be solid, liquid, or gaseous. In any case it must be material.

Assuming, then, an obstacle in the path of a wave of sound or light, a shadow should be produced; but since the edges are sources of secondary waves, according to Huygens's principle, these should encroach upon the shadow. The degree of encroachment can be expressed in a mathematical formula, and is thus shown to be proportional to the wave-length. The average length of a wave of green light is now known to be about $\frac{1}{60000}$ of an inch. The encroachment on the geometric shadow is hence so small that refined methods are needed to make it perceptible. In the case of audible sound, on the contrary, when propagated through air, the wave-length is ordinarily so great that the encroachment almost wholly masks the presence of any shadow whatever. For the pitch C, 132 vibrations per second, such as is often used by men in conversation, the wave-length is readily calculated, if we know the velocity of sound in air. Taking this as 1,120 feet per second, there will be 132 waves strung out over this distance in each second. The length of each is hence eight feet and six inches, or more than five million times as great as that of the average wave of light. For such waves it is hopeless to attempt producing any well-defined shadows.

One of the most familiar facts in physics is that the pitch of a note becomes higher, and hence its wave shorter, in proportion to the increase of vibration frequency. If well-defined sound-shadows are possible, we must resort to sounds of very short wave-length. If the sound is continuous instead of explosive, this shortness implies very high pitch. There are mechanical difficulties to contend with which make it hard to give much intensity to very acute sounds. The range of audition, moreover, is limited. For persons of good ear the range may be roughly stated as from 25 to 25,000 vibrations per second for sounds of small intensity; indeed, many fail to perceive any pitch exceeding 15,000. To exhibit sound-shadows, therefore, it becomes necessary either to employ a source that sends forth sounds of such high pitch as to be inaudible to most of those who are expected to perceive the shadow, or to resort to a momentary sound of great intensity and short wave-length.

Every one has noticed the decrease in intensity of the sound of a distant railway-train as it passes into a cutting. The observer is in a shadow which is incomplete but nevertheless noticeable.

The secondary waves, which are started at the upper edges of the cutting, reach the ear and give still a good idea of the character of the noise and position of the train. The range of the ear greatly exceeds that of the eye, not only in relation to the variety of wavelengths by which it may be impressed, but yet more as to variations of intensity. Just as sunshine and shadow during the day indicate merely variations in illumination without the complete extinction of light, so noise and sound-shadow are merely relative terms, the latter not necessarily implying the complete extinction of sound; for in air diffraction usually plays so important a part as to forbid complete extinction, and to prevent all sharpness of definition at the edges of the shadow.

When the medium is water instead of air, some new phenomena are noticeable. In 1826 Daniel Colladon's classic experiments on the velocity of sound in water were performed on the Lake of Geneva. The source of sound was a large bell, from which vibrations were conducted through the water several miles away to an elastic membrane stretched across the expanded opening of a partially submerged hearing-trumpet. They were thus given to the air within the trumpet and conveyed to an ear applied at its smaller end above the water. A bell when struck sends forth a variety of tones, and it is often hard to determine which of these is most prominent. Usually that of deepest pitch is the slowest to die away in air, and often it penetrates to the greatest distance. Colladon made the remarkable observation that in water the lower tones are conducted off to but a short distance before their energy ceases to produce the sensation of sound; while the initial stroke is propagated much further, and is then perceived as a short, sharp, almost clicking sound, without definite musical character. Placing the hearing-trumpet behind a wall which projected out into the water, the decrease of intensity was much greater than under similar conditions in air, and the demarkation of the region of shadow was decidedly more noticeable.

Still more interesting than the experiments of Colladon were those made in the Bay of San Francisco in 1874 by Prof. John Le Conte and his son, Mr. Julian Le Conte. The source of sound was not such as would give a definite pitch, like a bell, but the quick, violent, single impulse due to the explosion of dynamite employed in the blasting of rocks which obstructed the channels. The intensity of the shock thus propagated was such as to be felt as a blow on the feet of a person seated in a boat three hundred feet or more from the detonating cartridge, and to kill hundreds of fish. Several vertical posts or piles, each about a foot in diameter, projected from the ground out of the water in the neighborhood. A stout glass bottle was suspended in the water about a foot in the rear of one of these piles (Fig. 1), within the geometric shadow determined by lines supposed to be drawn from the cartridge forty feet horizontally away. The bottle was perfectly protected from the shock of the explosion. It was then put in front of the pile. The first shock shivered it into hundreds of fragments. Other bottles, some filled with air and some with water, were similarly exposed in various directions around the pile, and with the same result—destruction, except when within the protecting shadow. The experiments were varied by immersing stout glass tubes (Fig. 1), incased in thick paper, horizontally across the direction of the sound-rays in water, between two piles which were aligned with the dynamite cartridge. These piles were twelve feet apart, the nearer one being forty feet from the cartridge. Its shadow, therefore, just covered the second pile, and included the intermediate water, with the middle part of each tube. After an explosion these protected parts were found to be unbroken, while the ends which projected on the two sides beyond the shadow were completely shattered (Fig. 2). The boundary between the regions of shadow and noise was sharply defined on the tubes, even at a distance of twelve feet behind the protecting pile.

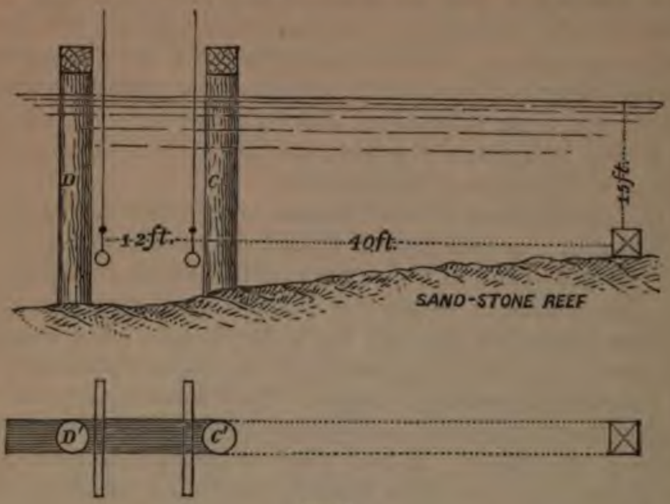

Fig. 1.

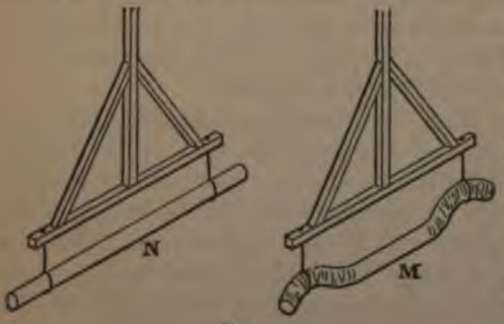

Fig. 2.

To account for the shortness of the sound-waves which were capable of producing such sharp shadows, Dr. Le Conte advances what seems to be the only tenable theory, and one which equally explains the observations of Colladon on the clicking sound of a distant bell as heard in water. In the absence of any recognizable pitch—for pitch implies a series of impulses recurring in regular order—there is no means of determining wave-length in these cases. But whatever this may be, the wave-length is equal to the product of the time consumed in generating the wave and the velocity of propagation. Thus, assume the initial pitch of a bell to be 220 vibrations per second. We may compute the wave-length either by considering that 220 waves are strung out over a distance of 1,120 feet, making each a trifle more than five feet long, or we may say that the time consumed in generating each wave is $\frac{1}{220}$ of a second, and that this impulse is propagated at the rate of 1,120 feet per second, which would be a little over five feet in $\frac{1}{220}$ of a second. The blow of the hammer on Colladon's bell was almost instantaneous, and the intensity of the first shock thus given to the water was far greater than that of any subsequent shock due to the succession of vibrations set up in the elastic bell-metal. The distance through which this intense sound would be propagated might be expected greatly to exceed that traversed by the subsequent weaker vibrations. The generating blow was so brief that the wave-length could only be short; and hence comparatively well-defined sound-shadows were produced at a distance. In the case of the dynamite explosions under water this reasoning holds with yet greater force. If the duration of the generating impulse be only a millionth of a second, and the velocity of propagation in water be 4,700 feet per second, the resulting wave-length would be only about $\frac{1}{17}$ of an inch. The quickness of action manifested in the explosion of dynamite exceeds that of any other known agent that has ever been similarly employed. The duration of the generating impulse may be considered indefinitely small, certainly immeasurably small. The sharpness of the sound-shadows it produces in water indicates a wave-length that can not exceed a small fraction of an inch.

The production of sharp sound-shadows in air is of more recent date than the experiments in water. In 1880 a dynamite-factory near San Francisco was destroyed by the explosion of its contents. On a large building three miles away many panes of window glass on the side toward the explosion were broken, and two shocks were felt, one conducted by the air and the other by the ground. In the acoustic shadow cast by this building, nearly nine hundred feet away on the side remote from the explosion, no aërial shock was experienced, though that from the ground was distinctly felt. The shortness of the air-wave due to exploding dynamite sufficiently accounts for the sharpness of the shadow.

But there is now no longer any necessity to resort to such dangerous sources of sound as dynamite. Whistles may be made which yield tones exceeding twenty thousand vibrations per second. The wave-length corresponding to such a pitch is less than an inch. The advantage presented is that the sound is continuous, and it may be made as constant as we please by supplying the whistle from a cylinder full of compressed air, regulating the pressure by means of an appropriate gauge. The disadvantage is that the intensity is but slight, and the pitch is too high to be perceived as sound by most persons unless the ear is closely applied. An artificial indicator must hence be used, whose motion under the disturbances due to sound can be seen at a distance.

In 1857 Prof. John Le Conte discovered that an ordinary naked gas-flame, from a fish-tail or bat-wing burner, becomes an indicator of sound by vibrating in unison with an external source, provided the pressure be such that the flame is just ready to flare. This can be easily shown by blowing a shrill whistle or bowing a tuning-fork of high pitch in the immediate neighborhood of the flame, which at once becomes forked (Fig. 3) into several long, vibrating tongues. The effect soon ceases if the pressure be gradually diminished. This result is due to the disturbance produced by sound-waves on the outflowing jet of gas at the nozzle. The high temperature of flame is therefore not necessary for the production of such co-vibration, but serves to make it more easily manifest.

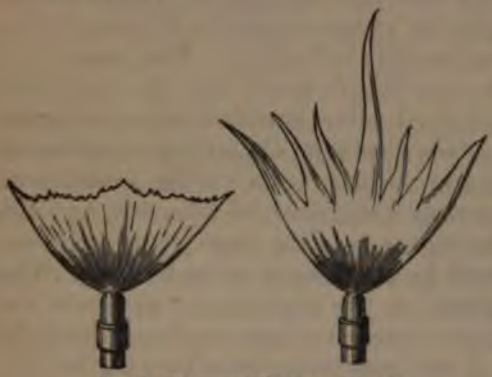

Fig. 3.—Sensitive Batwing Flames.

Nine years elapsed after Dr. Le Conte's discovery before the subject was taken up again and independently by Mr. W. F. Barrett, in London, who used small cylindrical jets, which were found to flare under similar conditions, and could be rendered far more sensitive. A "pin-hole lava-tip" may be fitted into the end of a metal tube and connected by means of India-rubber tubing to a cylinder of compressed illuminating gas. In connection with this, also, there should be a water manometer gauge for regulating the pressure of the outflowing gas. If the pin-hole is very smoothly cylindrical, the flame mounts up to the height of nearly eighteen inches (Fig. 4, *x*), with an apparent thickness scarcely more than that of the little finger, and burning quietly. When the pressure approaches ten inches, as indicated by the water-gauge, the flame flares, becoming much shorter and broader, like a little Indian club (Fig. 4, *y*), and producing a low roaring sound, due to the escape of unburned gas. Let the pressure now be diminished until this flaring barely ceases. The flame is now in its most sensitive condition. Sounds of low or even medium pitch have no effect upon it; but on blowing a shrill whistle, or rattling a bunch of keys anywhere within thirty or forty feet, it flares. Perhaps the most beautiful illustration of its sensitiveness is given by placing an open watch near the nozzle but not touching it; every tick causes a momentary sinking and spreading of the flame, so that the effect may be seen across an audience-room. If the audience applauds with clapping of hands, the flame shrinks in acknowledgment.

A very sensitive flame, but not so convenient as that of Prof. Barrett, and not visible at so great a distance, may be obtained with no pressure greater than that of the street mains, by causing the gas to issue from a small tube, over the orifice of which, at a height of an inch or two, is placed a piece of wire gauze (Fig. 5). The mixture of coal-gas and air is ignited above the gauze, and a glass tube may be used to protect the flame from currents of air, though this is not usually necessary. Very little adjustment is needed to find the distance between nozzle and gauze at which the flame is most sensitive. This arrangement was devised independently by Prof. Govi, of Turin, and Mr. Barry, of Ireland. The flame is deficient in brightness, and is only a few inches high at its best, but has the advantage of not requiring any appliances that may not be easily supplied in any town. If Barrett's flame is available, however, it is decidedly preferable to anything else.

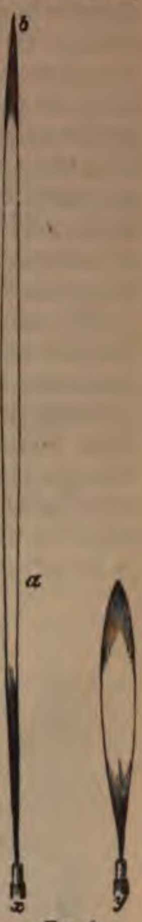

FIG. 4.

With such a flame as Barrett's it becomes possible to explore the air and detect regions of relative noise and silence, just as a delicate thermometer enables us to determine variations of temperature in different layers of air or water. If the pitch be too high for the ear to estimate or even detect it, the sensitive flame is more delicate than the ear. Armed with a whistle yielding a pitch of twelve or fifteen thousand vibrations per second, and with a good flame, many beautiful analogies between sound and light may be exhibited with entire satisfaction to an audience of deaf-mutes, if the lecturer's fingers are fairly nimble, since there is no necessity for the sounds to be heard. Most of the experiments about to be described were devised by Lord Rayleigh, the successor of Prof. Tyndall in the chair of Natural Philosophy at the Royal Institution in London.

Let the whistle be supplied with a continuous blast of air, or any compressed gas, at steady pressure. Four or five feet away from it is placed the nozzle of the burner from which the flame issues. Its sensitiveness may be regulated at will by means of the stop-cock and the water manometer gauge. Turning on the blast through the whistle, the flame flares. Let the open hand be held up between the two; the flaring ceases. The nozzle of the burner is in the acoustic shadow cast by the hand. If this result is not successfully attained at the first trial, the sensitiveness of the flame may be slightly modified to suit the conditions. The case is entirely analogous to that of the glass bottles in the experiments in San Francisco Bay.

By using a small mirror to reflect the sound-waves, their lengths may easily be measured in mid-air. Let the mirror be put a few inches behind the flame and moved slowly toward this or away from it. At certain distances the flame is observed to flare violently, and at certain other points it becomes quiet, though the sound has not been varied. Reflected waves are meeting advancing waves. Where they meet in like phases, their effect on the flame is intensified. But if the position of the mirror is so adjusted that the flame is at a point where the opposing waves meet in unlike phase, these neutralize each other and the flame ceases to be agitated. The case is like that of producing loops and nodes on a string attached at one end to a vibrating body and fixed at the other end. A series of sinusoidal curves travel over its length, and are reflected from the fixed end, producing the so-called stationary waves (Fig. 6). A returning sinusoid is superimposed on an advancing sinusoid, producing two loops, with an intermediate nodal point of rest and a node at the end. The whole sinusoid represents a wave-length, and the distance from node to node a half wave-length. The distance through which the mirror is moved from one point of flame quiescence to the next is a half wave-length for the pitch yielded by the whistle. In some experiments thus conducted by the writer, this distance was found to be a trifle over half an inch. The whole wave-length was 1·05 inch. Assuming the velocity of

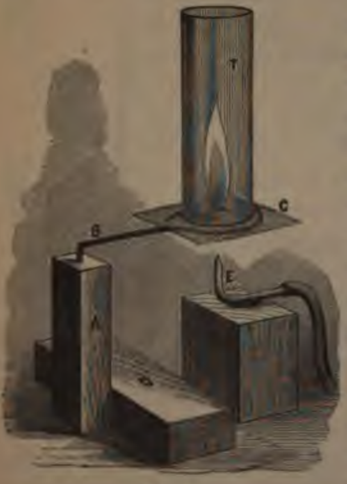

Fig. 5.

sound to be 1,120 feet, reducing this to inches, and dividing by 1·05 inch, the pitch of the whistle was thus found to be in the neighborhood of thirteen thousand complete vibrations per second. In no other way could this pitch be determined, for the most accomplished musician loses his power of discriminating pitch when either the upper or the lower limit of audition is approached. The pitch of the highest tone employed in music does not exceed five thousand vibrations per second.

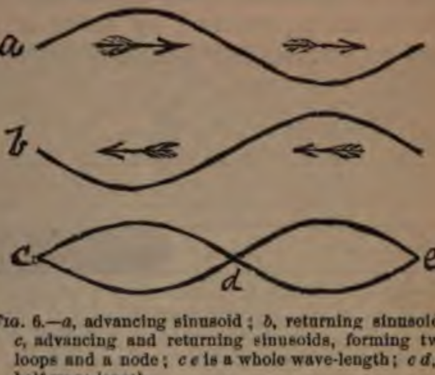

FIG. 6.—*a*, advancing sinusoid; *b*, returning sinusoid; *c*, advancing and returning sinusoids, forming two loops and a node; *c e* is a whole wave-length; *c d*, a half wave-length.

In performing this experiment Lord Rayleigh discovered an interesting peculiarity of the human ear in contrast with the sensitive flame. By using a tube, whose opening was placed alternately in the aërial loops and nodes, and conveying the sound thus to the ear at the same time that the flame was alternately agitated and quiescent, he found that the ear was most affected where the flame was least affected, and *vice versa*.

The flame, moreover, is unequally sensitive in two directions at right angles with each other. In drilling the small cylindrical hole of the burner no amount of care is sufficient to prevent minute irregularities. The current of issuing gas is not absolutely cylindrical. It is disturbed slightly by interior currents from side to side, and these affect the sensitiveness of the jet to external disturbances. To test this, let the nozzle be rotated on its own axis while the whistle is sounding, until the maximum effect is noticed; and let the sensitiveness of the flame be slightly reduced without causing it to cease to flare. On rotating the nozzle now through a right angle the flame is found to become quiet. Let a mirror be put on one side of the flame, a short distance off, so as to face the sensitive side. Adjusting it until it is equally inclined to the directions of flame and whistle, the flaring is started anew. This ceases when the mirror is rotated toward either side through a very small angle. Indeed, no more beautiful and exact illustration could be devised for showing the law of reflection of sound-waves. The sound-ray, taking a longer and broken path, disturbs the flame on its sensitive side, while the direct rays are at the same time beating in vain against what by analogy we may call its deaf side.

Probably the most interesting acoustic phenomena to be investigated by the aid of the sensitive flame are those of diffraction, or the measurable encroachment upon sound-shadows. In the accompanying diagram (Fig. 7) suppose the arrows to represent the direction of a group of parallel rays of either sound or light, the wave fronts being indicated by lines across the direction of the arrows. Waves in one phase are indicated by the continuous lines, and those in opposite phase by the dotted lines. At each edge of the obstacle are the centers of the secondary waves, whose fronts are represented by parts of circles. Behind the obstacle and on each side are points of interference represented by crosses and zeros. Behind it the secondary waves from opposite edges meet each other. At the sides, secondary waves interfere with the advancing main wave. Where like phases meet, the crosses represent points of increased disturbance. Where opposite phases meet, the zeros represent points of quiescence. If the waves are those of light, the crosses are points of increased brightness; the zeros, of comparative darkness. If the waves are those of sound, the crosses are points of noise; the zeros, of silence. Behind the obstacle there is a middle line of crosses; on each side of this a line of zeros; and outside of these are lines of crosses again. These lines are parts of hyperbolas, whose foci are the centers from which the secondary waves are started. This is readily seen by reference to the next illustration (Fig. 8). A necessary consequence is, that if light radiating from a point or a small aperture be interrupted by interposing a small disk in its path, there should be a line along the middle of the shadow behind it, at certain points of which brightness appears if a translucent screen is placed across the shadow. This fact was noticed by a Frenchman, Delisle, before the birth of either Newton or Huygens, but was of course not understood and was soon forgotten. Dr. Young seems not to have thought of it, or certainly never put this consequence

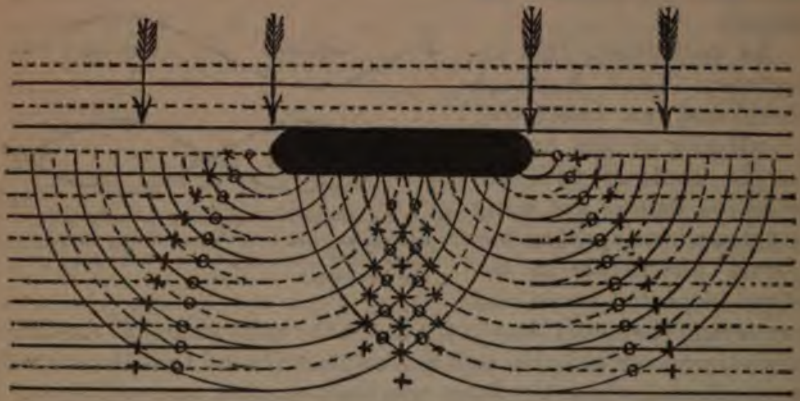

FIG. 7.—EXTERIOR AND INTERIOR DIFFRACTION.

of theory to any test. The first physicist to recognize the value of Young's optical papers was Arago, who at once adopted the wave theory and started his friend Fresnel on a series of optical researches that are now classic. In 1819 Fresnel gained a prize from the French Academy for his work on diffraction of light. Before the report was made to the Academy it was examined by the mathematician Poisson, who criticised it by showing that, if the wave theory were accepted, the shadow of a small disk should have a bright spot in the middle, due to diffraction, the illumination of which should be the same as if no disk had been interposed. Arago at once tried the experiment; and what Poisson had urged to prove the impossibility of Fresnel's views was found to be a startling proof of their correctness. The experiment is easily tested, requiring no more expensive apparatus than a mirror outside of an opening in a window, a small bullet suspended by a thin wire, and a piece of roughened glass to receive the shadow. A pin-hole through a sheet of tin foil covering the window opening yields the required light from the mirror. The acoustic analogue of this celebrated experiment was first accomplished a few years ago by Lord Rayleigh; it has been lately often repeated by the writer and perhaps others. A disk of cardboard about a foot in diameter is put between a whistle and sensitive flame, with careful adjustment of distance and sensitiveness. In certain positions the flame is protected within the shadow of the disk; but, by moving the latter to and fro, one position is found where it causes the flame to be violently agitated by the meeting of waves diffracted at the edge of the circle. The diffractive effect is the same as if the impervious disk were a lens converging the sound-waves to a focus.

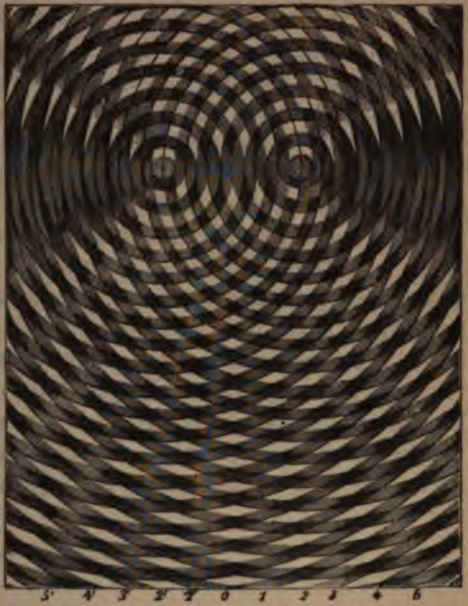

FIG. 8.—HYPERBOLAS PRODUCED BY INTERFERENCE OF WAVES.

The effect just described may be much intensified by constructing an acoustic diffraction grating and using it in place of the simple disk. The explanation of the principle on which such a grating is made is beyond the scope of the present paper.* Assuming its use, the sensitive flame enables us to detect a focal area of noise, at which the flame is violently agitated, and around this are alternate rings of silence and fainter noise diminishing in strength with increase of distance from the central focus.

By admitting light through two small openings close together, the waves coming from a distant bright point and hence reaching the two openings in the same phase, hyperbolic lines of interference like those shown in Fig. 8 were traced in space by Fresnel. The writer has recently done the same with sound-waves, using the sensitive flame as an explorer. Bands of alternate noise and silence have in like manner been traced by him in air, produced by interference between the waves proceeding directly from the whistle and those reflected from a smooth surface placed horizontally on the table.

The wave theory of sound has long been impregnable; but these beautiful analogies between light and sound, though provided for by theory, have been experimentally demonstrated only recently. Such new and unexpected confirmations, new points of contact, are always welcome, even though they be not needed for the establishment of a theory. They are the results of prevision based on the assumption that an elastic material medium is needed for the propagation of sound, and are wholly inexplicable on any theory of emanation analogous to Newton's emission theory of light.

CONDITIONS AFFECTING THE REPRODUCTIVE POWER IN ANIMALS.

By JAMES H. STOLLER,

ADJUNCT PROFESSOR OF NATURAL HISTORY IN UNION COLLEGE.

MODERN biology has made familiar the idea that animals are not fixed and unalterable in their bodily structure and functions, but, within a certain range, respond by changes in themselves to changes in their physical surroundings. This has always been observed to be true for the individual animal, as in the changes undergone in adaptation to the seasons of the year; mammals, for instance, acquiring a thicker coat of hair at the approach of winter, and reptiles and other classes passing into a low state of functional activity called hibernation or winter sleep. But it has now been well shown that this principle of modification by environment applies to species as well as to individuals. That is to say, in long periods of time species of animals are affected by changes in external conditions according to the same principle of natural law by which individual animals are affected in short periods. It is to be understood, of course, that species are affected by other causes than a changed environment—causes such as are included in Darwin's phrase of natural selection—but the fact of the modification of species becomes evident when it is seen that familiar observations made upon individual animals have an application to species also.

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* For this explanation the reader is referred to an article on "Diffraction of Sound," in the "Journal of the Franklin Institute," for June, 1889.

It is clear that the modifications thus undergone are primarily functional rather than structural, since no part of the animal body can be altered in its anatomical characters except through physiological action. But it is also true that functional modifications occur not merely as subordinate to structural changes but as ends in themselves. That is to say, functional activity may be increased or diminished in response to changes in external conditions without any necessary sequence in changes in the structure of the organs exercising the function. An illustration of this is found in the well-known fact that warm-blooded animals (excepting those that hibernate) need more food in winter than in summer to keep up their normal temperature, occasioning a considerably increased activity of the nutritive functions, but without any attendant structural changes whatever in the organs of alimentation. The same holds true with hibernating animals, which, on the other hand, take no food for a long period, the nutritive function being greatly reduced in activity, yet the organs exercising this function undergoing no structural changes. In respect to species of animals, we should not expect to find the principle hold true so strictly as in individual animals, since increased or diminished functional activity extending through many successive generations could scarcely fail to have some effect on organic structure. But the point to which special attention is here directed is that *function as well as structure* responds to changes of environment, and that variations in functional activity occur without any closely correlated changes in structure.

The present object is to show that the reproductive function in animals is profoundly affected by conditions of environment. It will be sufficient to state the law or principle according to which the activity of the reproductive power appears to be regulated, and then to adduce instances exemplifying the law.

When circumstances are such that most of the ova produced are likely to develop, and the young to reach maturity, then the reproductive function is least active; on the other hand, when by reason of lack of food-supply or danger of destruction by adverse physical conditions, or by natural enemies, it is probable that only a small proportion of the ova will give rise to mature animals, then the reproductive function is most active. The law may, therefore, be stated thus: The activity of the reproductive function is in proportion to the unfavorableness of the embryonic environment. The following instances are adduced:

TAPE-WORM.—The common tape-worm, *Tænia solium*, parasitic in the human intestine, consists in structure of a series of flat, oblong segments, sometimes eight hundred in number. Each of these segments is sexually perfect, containing both the male and female reproductive organs. The number of ova capable of development in each sexually mature segment is probably not less than five thousand. At this time the segment detaches itself from the others and is discharged from the body. In order that the ova shall develop, it is then necessary that they should gain access to the alimentary canal of the hog. If by chance they are swallowed by this animal, they quickly pass into the larval or cystic stage, burying themselves in the flesh or liver of their host, whence they may be transferred to the alimentary canal of man, where development is completed.

Now, it is obvious that this complex and fortuitous round of life renders the chances of the development of any single ovum exceedingly small. It is not probable, indeed, that one in ten thousand of the ova discharged from the alimentary canal of the host of the mature worm will ever reach the alimentary canal of the host of the larval worm. The embryonic environment is, therefore, in this case, exceedingly unfavorable by reason of its extreme narrowness. There is but one situation in which the development of the ovum can occur, and it is altogether accidental whether it reaches this situation. The explanation of the enormous capacity of the reproductive power in this animal is thus at once apparent. To compensate for the exceedingly narrow chances that the reproductive cell shall survive to complete issue, these cells are generated in excessive numbers.

APHIDES.—The aphides are commonly called plant-lice, and are very abundant in summer upon the leaves of most plants. They mature quickly, at least eight or nine generations following one another in a single summer. So prolific are they that it is entirely within bounds to say that a single insect may give rise to several millions of progeny, counting the successive generations, within a few months. This astonishing fertility is dependent upon a peculiar modification of the reproductive process in these insects. During the summer there are strictly no males nor females, but all are sexually alike, and are able to produce ova which develop *without fecundation*, this exceptional method of reproduction being termed *parthenogenesis*. Here, then, we have a remarkable variation of the reproductive function resulting in an enormous increase of prolificness. And here again we find an explanation of this variation in the conditions under which the young develop. These insects are a common prey for other animals, especially birds, which devour them in great numbers, their exposed condition upon the surface of leaves rendering them easily obtainable. Hence it is that of the total number of ova produced only a very small proportion result in an increase of their kind, the young insect being devoured before completing maturation. This extraordinary and anomalous increase of the reproductive power thus furnishes an extreme instance of the operation of the law under consideration.

THE OYSTER.—It is well known that the oyster is very prolific. A single individual may produce over a million young. It is generally known, too, that this animal has many natural enemies, the most destructive being the star-fish. It is obvious that the reproductive power is here in relation to the unfavorableness of the natural environment, and especially during the embryonic period, when the body is small and less adequately protected, being destitute of a shell in the earliest stages.

THE CODFISH.—While most fishes produce eggs in great numbers, the cod is especially remarkable in this respect, a single female depositing annually eight or nine millions. The liability of destruction of the ova and young is perhaps at its maximum here, there being many natural enemies and very slight means of defense. The application of the law is obvious.

It seems unnecessary to bring forward other instances to show that the law holds good when the conditions of embryonic life are unfavorable. While it can not be so strikingly shown when the opposite conditions prevail—when the circumstances of embryonic life are favorable—it scarcely seems doubtful that it is less applicable here. When animals have abundant food-supply and ample protection against their foes and against exposure to weather, etc., the reproductive function is generally only moderately active. Without citing particular instances, it may be sufficient to point out that the largest and most intelligent animals—those that are strongest in body and quickest in instincts, and thus best able to defend themselves and their young against their enemies and to secure food and shelter—are the least prolific, bringing forth young at longer intervals and in fewer numbers.

It may have occurred to the reader that while there thus seems to be a law governing the procreative power in animals, this law is yet subordinate to another more general, more fundamental law—the law of the preservation of the species. Nature guards against the destruction of her works, and the instances of excessive activity of the reproductive function we have noted are to be interpreted as efforts made in the economy of nature to save the species from extinction.

ISRAELITE AND INDIAN: A PARALLEL IN PLANES OF CULTURE.*

By GARRICK MALLERY.

I.

AXIOMS and postulates long limited man's study of man. This hampering has been peculiarly marked in reference to America, the assumption being that it must have been peopled from the eastern hemisphere, and that its languages, religions, and customs must have been inherited from nations registered in Eurasian records. Whatever was found here was assumed to have come through descent or derivation. The conceptions of autogeny and of independent growth, by which men in the same plane of culture act and think alike, with only the modifications of environment, had not arisen to explain observed facts.

Many authors have contended that the North American Indians were descendants of the "ten lost tribes of Israel." Prominent among them was James Adair, whose work, highly useful with regard to the customs of the southeastern Indians, among whom he spent many years, was mainly devoted to proof of the proposition. The Rev. Ethan Smith is also conspicuous. Even the latest general treatise on the Indians, published last year, and bearing the comprehensive title, "The American Indian," favors the same theory.

The authors of the school mentioned rest their case on the fact, which I freely admit with greater emphasis, that an astounding number of customs of the North American Indians are the same as those recorded of the ancient Israelites. The lesson to be derived from this parallel is, however, very different from that drawn by those who have advocated the descent in question.

The argument, strongly urged, derived from an alleged similarity between Hebrew and some Indian languages, especially in identity of certain vocables, may be dismissed forthwith. Perhaps the most absurd of all the coincidences insisted upon by Adair was the religious use of sounds represented by him to be the same as the word Jehovah. The "lost" Israelites when deported did not use orally the name given in the English version as "Jehovah," and the mode of its spelling and pronunciation is at this moment in dispute, though generally accepted as Jahveh; therefore, it would be most extraordinary if the tribes of Indians supposed to be descendants of the lost ten tribes of Israel should at this time know how to pronounce a name which their alleged ancestors practically did not possess.

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* Address of the Vice-President of the American Association for the Advancement of Science, Section H, Anthropology, delivered at the Toronto meeting, August, 1889.

Father Lafiteau was so much excited by coincidence in sound of some of the Iroquoian names and expressions with the language of the ancient inhabitants of Thrace and Lycia that he based thereon a theory of descent. On similar grounds ancestors of the Indians have been found among the Phœnicians, Scandinavians, Welsh, Irish, Carthaginians, Egyptians, Tartars, Hindus, Malays, Chinese, Japanese, and all the islanders of Polynesia. It is not wonderful that, with the choice of three hundred Indian languages, besides their dialects, from which to make selections of sounds, some one should be likened to some other language, for all spoken languages can in that manner—i. e., by a comparison of vocables—show identity of sound and a percentage of coincidences of significance. Philology now applies more discriminating rules of comparison.

But all arguments that the Indians are descended from the "lost tribes" are demolished by the fact, now generally accepted, that those tribes were not lost, but that most of their members were deported and absorbed, their traces remaining during centuries, and that others fled to Jerusalem and Egypt. If any large number of them had remained in a body, and had migrated at a time long before the Columbian discovery, but later than the capture of Samaria in the seventh century B. C., their journey from Mesopotamia to North America would have required the assistance of miracles that have not been suggested except in the Book of Mormon.

For brevity, the term "Indians" may be used—leaving the blunder of Columbus where it belongs—without iterating their designation as North American, though I shall not treat of the aboriginal inhabitants south of the United States. This neglect of Mexico and Central and South America is not only to observe my own limits, but because some of the peoples of those regions had reached a culture stage in advance of the northern tribes. To avoid confusion, the term "Israelites" may designate all the nation. Although the tribes became divided into the kingdoms of Israel and of Judah, when it is necessary to speak of the northern tribes they may be designated as the kingdom of Samaria. The shortest term, Jews, would be incorrect, as the people now scattered over the world and called "Jews" are chiefly the descendants of the southern branch or fractional part of the children of Israel, and have a special history beyond that common to them and their congeners.

The parallel presented is not selected because its two counterparts are more similar to each other than either of them is to other bodies of people among the races of the earth. A similar parallel can be drawn between both the Indians and the Israelites and the Aryan peoples, from which I and most of my hearers are supposed to have descended. The selection is made for convenience, because this audience is assumed to be familiar with the Old Testament, so that quotations and citations from it are less necessary; and also because many of them in this, the Anthropologic Section, are familiar with the Indians, so that the collocation of facts without a prolix statement is sufficient for comparison.

Although the Indians are divided into fifty-eight linguistic stocks and three hundred languages, and although there is great variety in their manners, customs, and traditions, yet there is sufficient generic resemblance between all of them to afford typical instances, where European civilization and missionary influence have not effected serious change, or where the early authorities are reliable. It is essential to examine the other side of the parallel —the Israelites—at a period coincident in development with that of the Indians. That part of the history and records of the Israelites must be chiefly considered which relates to the times before they had formed a nationality and had become sedentary. The general use of writing was nearly contemporaneous with that nationality, and the era of King David is a proper demarkating line. The Indians never having arrived at the stage of nationality, though some of them (as the Iroquois and the Muskoki) were far on the road to it, and never having acquired a written language, their stage of culture at the Columbian discovery shows a degree of development comparable with that of the Israelite patriarchal period and the early Canaanite occupation before the rule of kings.

It is important to establish the time when writing was first known among the Israelites, because then their traditions would first become fixed. No reliable history can exist before writing. An illiterate people remembers only fables and myths; from these the history of the years before writing was used must be winnowed. There is no reason to suppose that the Hebrew language was written at the time of the exodus, though some such mnemonic system might have been invented as was used by several of the Indian tribes. If Moses had all the knowledge of the Egyptians, but no more, he could not have used any better mode of writing than their hieratic, in which it was not possible to write intelligibly any long document in the Hebrew language, simply because the advance made by the hieratic, in which the use of phonetics began, was not sufficient to express all the Hebrew vocables.

There has been an attempt to show that the old Hebrew alphabet, which has been classed as partly Phœnician and partly Babylonian, was obtained from Assyria at a time before the exodus, but the proposition is not yet established. Even if Assyrian characters adaptable to the Hebrew language did then exist, it is not probable that the Israelite herdsmen and bondmen did so adapt them. If any one of them—e. g., Moses—had done so as an individual act, the feat would have had but one historic parallel, which would have furnished another coincidence between Israelite and Indian. It was performed by the Cheroki, Sequoia, who in less prosaic days would have become the hero of a Kadmos myth. But Sequoia left very distinct marks of his invention, while there is no evidence that the Israelites possessed an alphabet before they settled in Canaan, and there are strong inferences against that supposition.

The compilers of the Old Testament felt no doubt that the law could have been written on Sinai at the time of the exodus. They knew how to write and knew that their predecessors for several generations had written, so it did not occur to them that there had ever been a time in which persons of the higher classes were ignorant of writing.

It is probable that in the days of Samuel the Israelites had made some progress in the art of writing. An alphabet had been known to some of them before; but its common use is of greater consequence, and that depends much upon the substances used for writing, their cost, and the convenience of procuring them. The use, not the mere invention, of writing, not only divides the mythical and the historical periods, but reacts upon the character of the people in all their institutions, forming a new epoch in culture. The people did, perhaps, write under David at about 1100 B. C.

Moses flourished about fifteen centuries before Christ, and the oldest legends relating to him are, in their present shape, four or five centuries later than his death. He did not practically organize a new formal state of society, or if he did, temporarily, by his personal power, it had no direct consequence or historical continuity. The old system of clans and religions continued as before. If the legislative portion of the Pentateuch was the work of Moses, it remained a dead letter for centuries, and not until the reign of Josiah did it become operative in the national history.

The historical account undoubtedly states that Moses was, by inspiration, the founder of the Torah; but the question is, What was that Torah? It was not the finished legislative code. Long after the exodus a dramatic account was furnished of the promulgation of the whole law at Sinai to produce a solemn impression, and thus the code, which had slowly and imperceptibly grown during centuries, was represented as having been pronounced on one occasion celebrated by tradition as momentous.

The code now ascribed to Moses was a revised code, and in an unusual sense a mosaic work. When the Israelites attained the use of writing they did as all people in the world have done when they began to use writing—i. e., they wrote out their own myths, traditions, and legends as they knew them at the time of writing.

But during the long time in which the traditions were transmitted orally, the growth of the nation's ideas produced a change in them without any fabrication or design, and it is probable that the traditions affected only to this extent were set forth in the earlier documents, long since lost, namely, the "Book of the Wars of Jahveh" and the "Jasar." There were, however, special temptations in the later history of Israel, in the contests between the Elohists and the Jahvists, to manipulate the earlier documents. When the compilers belonging to the two schools produced the two versions, intermixed and confused in the books we now have, they differed from all people in history if the contestants, for political and personal power, did not color the records to suit their own views.

Students who have devoted their lives to the study of the last compilation have been able to identify, by linguistic and historical exegesis, the fragments of the original traditions, the epic tales of the first documents, the theocratic deductions and the later sacerdotal visions, though the two versions appear on the same page and sometimes in the same paragraph. The results of this immense labor by the Hebraists of this generation have lately been presented by Renan in a popular form. His works, as well as those of other authors whose names will be mentioned in this address, I have used freely, though generally without exact quotation.

In addition to the linguistic and historical tests, other internal evidences, especially the antedating of conceptions several centuries (some instances of which will be mentioned), show that the books, as now presented, were written long after the periods referred to in them.

The main document on the primitive age is the Book of Genesis, regarded for the reasons mentioned, not as literally historical, but as the tradition, written at a respectable antiquity, of an age that really existed. In examining it the historical part is discovered, not by belief in the miraculous, but by the proper comprehension of the mythical.

Much can be learned from myths and legends of the times anterior to strict history. The Homeric epics are not history, yet they throw a flood of light upon Greek life a millennium before the Christian era. The ante-Islam tales and the Arthurian and Niebelungen romances of the middle ages are not true in fact, yet they are storehouses, preserving the social life of the days when they were composed and to a less though still useful degree of the time embraced by the still earlier traditions. The generalizations derived from the details of ancient texts are truths obtained by induction.

It is expedient to make a disclaimer before entering upon the necessary comparisons of religions. I absolutely repudiate any attack upon any religion. Let us learn a lesson from the Indians, not only in tolerance but in politeness. One of the early Jesuit missionaries in Canada recounts how he pleased a Huron chief by his discourse upon the cosmology set forth in the Scriptures, and felt that he had secured a convert until the chief, thanking him for his information, added, "Now you have told me how your world was made, I will tell you how my world was made"; and proceeded to give the now familiar story of the woman falling from the sky, and the turtle. He was willing that the priest should retain his belief, with which his own, in his opinion, did not conflict. Dr. Franklin tells of a Susquehannock who, after a similar lecture from a Swedish missionary, was answered in the same manner; but this missionary became angry and interrupted the Indian, whereupon the latter solemnly rebuked him with pity: "I have listened politely to what you told me; if you had been properly brought up, you would have believed me as I believed you."

Religion, as accurately defined, embraces only the perficient relations between divinity and man, and the mode in which such relations operate. Popularly it includes cosmology and theology. For present convenience the broad subject may be divided into Religious Opinions and Religious Practices.

In this comparison, all religious views personally entertained must be laid aside and the study conducted strictly within the scope of anthropology. Modern thinkers adopt the rule not to use a miraculous factor when unnecessary. *Nec deus intersit, nisi dignus vindice nodus.* It is now regarded as puerile to explain all puzzling phenomena, as was done for ages—

"When solved complete was any portent odd
By one more story or another god."

This attitude, however, is still not universal. When experience of observed facts and of the orderly working of the forces of nature are not sufficient for explanation, some minds yet resort to the miraculous. Others humbly confess ignorance and work for light. This light when gained is real and lasting, not the delusive hues of cloud-region, varying with each instant and to each observer's eye, and soon resolving into the same old mists and fogs from which escape was sought.

In their explanation of phenomena, all the peoples of the world have resorted to revelations. Every myth or early teaching is directly or indirectly through revelation; but as the revelation is on both sides of the equation, it can be eliminated from any parallel such as is now presented.

A cardinal of more than titular eminence was rash when, admitting that the doctrine of the devil and his command of demons was first learned by the Israelites during the Babylonian captivity, he insisted that it might be divine revelation, notwithstanding its immediate source. He said that if God made Balaam's ass speak, it would also be easy for him to provide that the heathen should give correct instruction. The non-existence of Satan is not demonstrable; so it may be well to examine into subjects on which we have knowledge, such as geology and astronomy. It appears from bricks in palaces at Nineveh that the Mosaic cosmology was also obtained from the same source as the Satanic doctrine. Any revelation on the subject would in order of time have been given to, and according to all evidence was promulgated by, the cultured Assyrians, not the ignorant captives. The priority, however, is of little moment, as the revolving dish-cover theory, whether as originally noted on clay or on rolls of sheep-skin, is now obsolete. All dependence on revelations practically means that those suiting us are true and all others false. When judgment upon the truth or falsehood of an alleged revelation can be made in accordance with the prejudices of the judge, the subject becomes too eclectic and elastic to be considered by science, or indeed by common sense.

The scope of anthropology is to study within the category of humanity. If theology comes from man's conceptions, it is embraced in anthropology. If theology is of divine origin, anthropology may discuss what men think and do about it. But the truth or falsity of revelation can not be dealt with in this address. To raise that point acts as a *clôture*, cutting off all debate.

RELIGIOUS OPINIONS.—Religious writers have often explained the differences in beliefs among the various peoples of the world on the hypothesis that true religious knowledge was implanted at one time in the ancestors of all those peoples, and that the divergence now found is through decay of that supernatural information. The early missionaries to America, of all denominations, were imbued with this dogma and sought, and therefore found, evidences of the one primeval faith. Sometimes they limited themselves to the similar beliefs of the Indians and the Israelites, but often they passed beyond that stage to locate the vestiges of Christianity. These they said came by the hands of Christian pre-Columbian visitors, and one explanation was by the importation of the apostle Thomas. The coincidences found were exaggerated, but when facts were opposed they were not less satisfactory, as the adverse power of Satan then appeared. Such mental predetermination nearly destroys the value of those missionary accounts.

The most generally entertained parallel between the Indians and the Israelites, repeated by hundreds of writers, was that they both believed in one overruling God. This consensus, if true, would at once establish a beatific bridge of union between the two peoples, but its iris arch vanishes as it is viewed closely.

After careful examination, with the assistance of explorers and linguists, I reassert my statement, published twelve years ago, that no tribe or body of Indians, before missionary influence, entertained any formulated or distinct belief in a single, overruling "Great Spirit," or any being corresponding to the later Israelite or the Christian conception of God. All the statements of the missionaries and early travelers to the opposite effect are erroneous. Even some of the earliest writers discovered this truth. Lafiteau says that the names "Oki" and "Manito" were given to various spirits and genii. Champlain said that Oki was a name given to a man more valiant and skillful than common. Manito signifies "something beyond comprehension." A snake was often a manito, and seldom were snakes molested. "Hawaneu," reduced to correct vocables, only means loud-voiced—i. e., thunder. "Kitchi Manito" is not a proper name for one god, but an appellation of an entire class of great spirits. So with the Dakota term "Wakan," which means only the mysterious unknown. A watch is a wakan. The Chahta word presented as "God" for two centuries is now found to mean a "high hill."

Some Indians, perhaps, had a vague idea of some good spirit or being whom they did not worship and to whom they did not pray. They prayed and sacrificed to the active daimons, concerning whom they had many myths. In their various cosmologic myths there was sometimes a vague and unformulated being who started the machinery by which the myth proceeded; but when once started no further attention was paid to such originator. Perhaps some modern advanced thinkers have no clearer definition of a great first cause.

Praise has been lavished upon the Indians because they did not take the name of God in vain. The true statement, however, has a different significance. They did not, according to the best linguistic scholars, have any word corresponding with the English "God" either to use or misuse, and they deserve no more praise for avoidance of profanity than for their total abstinence from alcoholic drinks before such had been invented or imported. The terms too liberally translated as "Master of Life" and "Maker of Breath" were epithets merely. Perhaps there was an approach to a title of veneration when the method of their clan system was applied to supernatural persons, among whom there would naturally be a chief or great father of the "beast gods," on the same principle as there was a chieftaincy in tribes.

The missionaries who have persistently found what did not exist are not without excuse. Wholly independent of any design to force welcome answers, an interviewer who asks a leading question of an Indian can always obtain the answer which is supposed to be desired. The sole safe mode of reaching the Indian's mental attitude is to let him tell his myths and make his remarks in his own way and in his own language. When such texts are written out, translated, and studied they are of great value. It is only within about twelve years that this has been done in a systematic manner, but it has already resulted in the correction of many popular errors.

In attempting to translate the epithets mentioned, the missionaries and travelers often honestly used the word which, in their own conception, was the nearest equivalent. An instructive example is where Boscana describes a structure in southern California as a "temple." It was a circular fence, six feet high, not roofed in—a mere plaza for dancing; but the dancing was religious, and the word "temple" was the best one he could find, by which mistake he has perplexed archæologists who have sought in vain for the ruins.

A consideration not often weighed is that the only members of the Indian tribes who are willing to give their own ideas on religious matters to foreigners are precisely those who are most intelligent and most dissatisfied with their old stories. There were minds among them groping after something newer and better, and it would be easy to translate their vague longings into the conception of an overruling Providence. But the people had made no such advance.

The missionaries who announced that the Indians were fixed in the belief in one god were much troubled by the statement of the converted native, Hiaccomes, of Martha's Vineyard, who, having enumerated his thirty-seven gods, gave them all up. This, however, was a typical instance of the truth. The Indians had an indefinite number of so-called gods corresponding with the like indefinite number of the Elohim of the Israelites before the supremacy of Jahveh.

The biblical religion of Israel has been popularly held to be coeval with the world, but its own beginning was by no means archaic. About a thousand years before Christ it did not exist, and at least four hundred years were required for its development. The religious practices of David and Solomon did not materially differ from those of their neighbors in Palestine. Not until the time of Hezekiah, about seven hundred and twenty-five years before Christ, did the Israelite religion attain to a distinct formulation. Its ordinances and beliefs advanced from crudity and mutation to ripeness and establishment. It was a system long in growth, and so could not early possess authoritative documents.

The nomad Semite believed, with other barbarians, that he lived amid a supernatural environment. The world was surrounded and governed by the Elohim—myriads of active beings, seldom with distinct proper names, so that it was easy to regard them as a whole and confound them together. Yet the power bore different names in different tribes. In some cases it was called El, or Alon, or Eloah; in other cases Elion, Saddai, Baal, Adonai, Ram, Milik or Moloch.

The Elohim, though generally bound together, sometimes acted separately; thus each tribe gained in time its protecting god, whose function was to watch over it and direct it to success.

In the transition to nationality, the Israelites conceived a national god, Jahveh, who was not just, being partial toward Israel and cruel toward all other peoples. The worship of a national god is not monotheistic, but henotheistic, recognizing other gods of other peoples. The work of the later prophets consisted in restoring the attributes of the ancient elohism under the form of Jahveh, and in generalizing the religious cult of a special god.

Jahveh was not at first the god of the universe, but subsequently became so because he was the God of Israel, and very long afterward was claimed to be the only god, mainly because the Israelites claimed to be the peculiar people. Even down to the time of the prophet Isaiah, there was alternation of conflict and of co-ordination between Jahveh and the other gods of Canaan, especially Baal.

The revolution accomplished by the prophets did not change expressions. The concept of Jahveh was too deeply rooted to be removed, and the people spoke of Jahveh as they had formerly spoken of the Elohim. He thus became the supreme being who made and governed the world. In time even the name of Jahveh was suppressed and its utterance forbidden; and it was replaced by a purely theistic word meaning the Lord. Undoubtedly the prophets, at the time of the kings and later, taught the worship of one God, but the people were not converted to the doctrine until after the great captivity.

When established in Palestine, the Israelites entered into communion with the Canaanites, their kindred, and worshiped Baal. Later they frequently bowed down to the Dagon of the Philistines, probably because he was the god of their warlike victors. Solomon, perhaps from admiration of Sidonian culture, introduced the service of Astarte, which was intermitted; but later, Ahab established the worship of the Sidonian divinities in the kingdom of Samaria. It was subsequently readopted in the kingdom of Judah, and not until the reign of Josiah were the Sidonian altars finally demolished.

The true parallel, therefore, between the Indians and the Israelites, as to belief in a single overruling God, is not that *both*, but that *neither*, held it.

In the stage of barbarism all the phenomena of nature are attributed to the animals by which man is surrounded, or rather to the ancestral types of these animals, which are worshiped. This is the religion of zoötheism. Throughout the world, when advance was made from this plane, it was to a stage in which the powers and phenomena of nature are personified and deified. In this stage the gods are anthropomorphic, having the mental, moral, and social attributes of men, and represented under the forms of men. This is the religion of physitheism. The most advanced of the Indian tribes showed evidence of transition from zoötheism to physitheism. The Israelites, in the latter part of the period selected, showed the same transition in a somewhat higher degree than the Indians did when their independent progress was arrested.

It is needless to enlarge upon the animal gods of the Indians, or to furnish evidence that they gave some vague worship to the sun, the lightning, to fire and winds.

There is no doubt that the Israelites were for a long period in the stage of zoölatry. They persisted in the worship of animal gods—the golden calf, the brazen serpent, the fish-god, and the fly-god. The second commandment is explicitly directed against the worship of the daimons of air, earth, and water, which is known to have been common; and the existence of the prohibition shows the necessity for it, especially as it was formulated, after the practice had existed for centuries, by a religious party which sought to abolish that worship.

The god of Sinai was a god of storm and lightning, which phenomena were strange to the Israelites after their sojourn in plains. The ancient local god of the Canaanites began in the exodus to affect the religious concepts of the Israelites, so that they associated Jahveh with the god whose lands they were planting and whose influence they felt. Sinai was thenceforward the locality of their theology. Jahveh, through all after-changes, remained there as his home; he spoke with the voice of thunder, and never appeared without storm and earthquake.

Another class of gods connected with beast-worship and also with the totemic institution (to be hereafter specially noted) was tutelar, the special cult of tribes, clans, and individuals. It was conspicuous both among the Israelites and the Indians.

Jahveh may first have been a clan or tribal god, either of the clan to which Moses belonged or of the clan of Joseph, in the possession of which was the ark. No essential distinction was felt to exist between Jahveh and El, any more than between Ashur and El. Jahveh was only a special name of El, which had become current within a powerful circle, and which, therefore, was an acceptable designation of a national god. When other tutelar gods did not succeed, there was resort to Jahveh, probably in the early instances because he was the most celebrated of all the tutelar gods, and the reason for that celebrity was that the most powerful of the clans claimed him as tutelar.

Hecastotheism is a title given to the earliest form of religion known, which belongs specially to the plane of savagery. In it every object, animate or inanimate, which is remarkable in itself or becomes so by association, is a *quasi* god. The transition between savagery and barbarism, as well as between the religions of hecastotheism and zoötheism, connected with them, was not sharply marked, so that all their features could coexist at a later era, though in differing degrees of importance.

This intermixture is found both among the Israelites and Indians. An illustration among many is in the worship of localities and of local gods. Conspicuous rocks, specially large trees, peculiar mountains, cascades, whirlpools, and similar objects received worship from the Indians; also the places where remarkable occurrences, as violent storms, had been noted; and among some tribes the particular ground on which the fasting of individuals had taken place, with its accompanying dreams. The Indians frequently marked these places, often by a pile of stones. The Dakotas, when they did not have the stones, used buffalo skulls.

In the Old Testament frequent allusions are made to a place becoming holy where dreams or remarkable events had occurred. They were designated by pillars. The Israelite compilers adopted the pillar of Bethel for the same reason that required Mohammed to adopt the Caaba. Though struggling for monotheism, they could not always directly antagonize the old hecastotheism.

Future State.—The topic of a future state may be divided into (1) the simple existence of the soul after death, (2) the resurrection of the body, and (3) a system of rewards and punishments in the next world.

The classical writers often distinguished two souls in the same person—one that wandered on the borders of the Styx until the proper honors had been given to the corpse; the other being a shadow, image, or simulacrum of the first, which remained in its tomb or prowled around it. The latter could be easily invoked by enchanters.

Some of the Indians thought that the souls of the dead passed to the country of their ancestors, from which they did not dare to return because there was too much suffering on the road forward and backward. Nevertheless, they believed that there was something spiritual which still existed with their human remains, and they tell stories of it. Thus there are two souls, and the Dakotas have four, one of which wanders about the earth and requires food, the second watches over the body, the third hovers around the village, and a fourth goes to the land of spirits.

The Iroquois and Hurons believed in a country for the souls of the dead, which they called the "country of ancestors." This is to the west, from which direction their traditions told that they had migrated. Spirits must go there after death by a very long and painful journey, past many rivers, and at the end of a narrow bridge fight with a dog like Cerberus, and some may fall into the water and be carried away over precipices. This road is all on the earth; but several of the Indian tribes consider the Milky Way to be the path of souls, those of human beings forming the main body of the stars, and their dogs, which also have souls, running on the sides. In their next world the Indians do the same as they customarily do here, but without life's troubles.

The Israelites believed in a doubling of the person by a shadow, a pale figure, which after death descended under the earth and there led a sad and gloomy existence. The abode of these poor beings was called Sheol. There was no recompense, no punishment. The greatest comfort was to be among ancestors and resting with them. There were some very virtuous men whom God carried up that they might be with him. Apart from these elect, dead men went into torpor. Man's good fortune was to be accorded a long term of years, with children to perpetuate his family and respect for his memory after death.

The Indians did not believe in existence after death in a positive and independent state. The spirit does not wholly leave the body and the body is not resurrected. Perhaps a good commentary upon their belief is furnished by a tribe of Oregon Indians who, hearing missionaries preach on the resurrection, immediately repaired to an old battle-field and built great heaps of stones on the graves of their fallen foes to prevent their coming up again. They did not want any of that.

Among the Israelites the resurrection of the body was a foreign idea imbibed during the captivities in Assyria and Babylonia. Perhaps the first reference made to it is in the prophet Daniel. It was not fully believed in so late as the procuratorship of Pontius Pilate.

Among the Indians privation of burial and funeral ceremonies was a disgraceful stigma and cruel punishment. There was trouble about children who died shortly after their birth, and also about those whose corpses were lost, as in the snow or in the waters. In ordinary cases of death the neglect of full and elaborate ceremonies caused misfortune to the tribe.

The story of the "happy hunting-ground" among the Indians has not been generally apprehended. As regards what we now consider to be moral conduct there was no criterion. A good Indian was one who was useful to his clan and family, and at the time of his death was not under charges of violating the clan rules, for which the Polynesian word *tabu* has been adopted. The moral idea of goodness of a Pani chief is to be a successful warrior or hunter. The actual condition at the moment of death decided the condition in the future far more than any conduct during the past. In the portions of the continent where the scalp was taken, the scalped man remained scalped in the world of spirits, though some tribes believed that scalping prevented his reaching that world. If he had but one leg or eye here, he had but one leg or eye afterward. In tribes where they cut off the ears of slain foes the spirit remained without ears. A special instance is where the victim was considered too brave to be scalped, but the conquerors cut off one hand and one foot from the corpse to keep him from inflicting injury upon the tribe of the conquerors in the next world. Some of the tribes thought that if an Indian died in the night he remained in total darkness ever afterward.

One of the most curious of their beliefs was in connection with drowning and hanging, the conceit being that the spirit (which was in the breath) did not escape from the body. This doctrine was made of special application to prevent suicide, which was generally performed either by hanging or drowning, the deduction being that suicides could not go to the home of the ancestors.

It is probable that the various trials which the spirit is supposed to undergo before reaching the other world were devised to secure confidence in the absence thereafter of the ghosts of the dead, because the same difficulty would attend their return. As without the assistance of mortuary rites the ghosts would not be able to reach their final home, their permanent absence was secured because there were no repetitions of those rites to assist their return. Fear of the ghosts, not only of enemies but of the dearest friends, generally prevailed. After a death all kinds of devices were employed to scare away the spirit. Sometimes a new exit, through which the corpse was taken, was cut through the wigwam and afterward filled up, it being supposed that the spirit could re-enter only by the passage through which it went out. Sometimes the whole wigwam was burned down. There was often a long period, which travelers called that of mourning, during which drums and rattles were used to drive away the spirits. After firearms were obtained, they were discharged in and around the late home of the deceased with the same object. The loud cries of so-called lamentation had probably a similar origin, and this is more marked when the lamenters were strangers to the dead, and even professionals, not unlike the Irish keeners.

In this general connection it is proper to allude to the common abstinence from pronouncing the true name of any dead person. This is more distinct than the sociologic custom where the man's true name should not be used in his life except on special occasions. There was some fear that, by calling his name, he might come back.

It would be wrong to accuse the Indians of want of feeling indicated by their horror of the dead. In one of the most ancient accounts—that of Cabeza de Vaca—it is declared that the parents and other relatives of the sick show much sympathy while life remains, but give none to the dead—do not speak of them or weep among themselves, or make any signs of grief or approach the body. This domestic reticence is entirely different from, but not antagonistic to, the obligatory mortuary rites which were practiced.

To secure the living from the presence of the spirits of the dead was the first object, and the second was to assist those spirits in the journey to their destination. These were the prevailing ideas of all the mortuary customs of the Indians. It may be true that there was in some cases (though missionary influence is to be suspected) a belief that there were two different regions in which the bad and the good would severally remain, but that was not of general acceptance. There was but one future country, and the only question was whether the spirits got there or not. There was no hell.

The Israelites, in their sacred books, do not show the influence of fears or hopes concerning a future state with reference to individual morality. Among them death at any age was not an inevitable necessity, as they thought that life might be prolonged to an indefinite extent, but it was inflicted as a punishment and their signs of mourning were acts of penitence and contrition, with the idea that the survivors might have been the cause of the death. All deaths were classed with public calamities, such as pestilence, famine, drought, or invasion, being the work of an enemy—perhaps a punishing god, perhaps a daimon or a witch. They regarded it so great an evil to die unlamented that it was one of the four great judgments against which they prayed, and it was called the burial of an ass. These are the inferences to be derived from the books as we have them. It is, however, questionable whether rites attending upon death were not with them similar in intent to those of the Indians—i. e., to provide, by means of those rites, for the future welfare of the departed, rather than in accordance with our modern sentiment, to show respect and personal sorrow. Passages of the Old Testament may be noted—e. g., the one telling how the bodies of Saul and his children were rescued from Bethshan and taken to Jabesh, where they were burned and the bones buried. The ceremony in this case and others seems to have been the burning of the flesh and the burial of the bones, as was frequently done by the Indians on occasions of haste, without waiting as usual for the decay of the flesh, the later gathering of the bones being at stated periods of years.

There is no evidence that the Israelites feared the corpse and its surroundings beyond that to be inferred from the ordinances concerning pollution, which, however, are significant.

RELIGIOUS PRACTICES.—There should always be a cross-reference in thought between what in time became a religious practice and the earlier sociology, to be mentioned in its place, with which it was closely connected.

Josephus remarks about the Israelites that "beginning immediately from the earliest infancy, nothing was left of the very smallest consequence to be done at the pleasure and disposal of the person himself."

The same is true regarding the Indians. Their religious life is as intense and all-pervading as that of the Israelites. It is yet noticed in full effect among tribes as widely separated, both by space and language, as the Zuñi and the Ojibwa, and their practices are astonishingly similar in essence and even in many details to some of those still prevailing in civilization.

Among the Hurons and Iroquois there were religious rites for all occasions, among others for the birth of a child, for the first cutting of its hair, for its naming, and for its puberty, for the admission of a young man into the order of warriors, and the promotion from warrior to chieftain, for making a mystery-man, for first using a new canoe, for breaking tillage-ground, for sowing and harvest, for fixing the time to fish, for deciding upon a warlike expedition, for marriages, for the torturing of captives, for the cure of disease, for consulting magicians, invoking the daimons, and lamenting the dead.

Shamans.—Among the Indians there was frequently an established and recognized priesthood, provided by initiation into secret religious societies, corresponding in general authority to that of the Levites, although the order of the latter was instituted in a different manner, perhaps imitated from the exclusive class of the priesthood in Egypt. The shamans in all tribes derived a large part of their support from fixed contributions or fees.

Adair describes a special ceremony for the admission or consecration of a priest among the southern tribes, as follows: "At the time of making the holy fire for the yearly atonement of sin the Sagan clothes himself with a white ephod, which is a waistcoat without sleeves, and sits down on a white buckskin, on a white seat, and puts on it some white beads, and wears a new pair of white buckskin moccasins, made by himself, and never wears these moccasins at any other time."

Similar exclusive use by the high priest of the garments used on the day of the atonement is mentioned in Leviticus.

In addition to the organized class referred to, there were other professional dealers in the supernatural who may be called conjurers, sorcerers, or prophets. They were independent of and often antagonistic to the regular shamans. Instance the Jossakeed of the Ojibwa, rivals of the Midé, as the Israelite prophets were of the Levites. At the time of the Judges the prophets were isolated and without any common doctrine. These irregular practitioners arrived at recognition individually by personal skill in an exhibition of supernatural power—that is, they wrought miracles to prove themselves genuine.

At the time of the exodus there were, among all the Semitic tribes, sorcerers who possessed mysterious secrets and enjoyed some of the power of the elohim. They were paid to curse those whose ruin was desired. Balaam was the most distinguished sorcerer of that time.

One of the most frequent purposes for employing supernatural agency was to bring on rain in time of drought. The practitioner generally tried to delay his incantations as long as possible in hopes of a meteorologic change. Sometimes, on failure, he was killed, as he was supposed to be an enemy who possessed the power he professed but was unwilling to use it; and to prevent this dangerous ordeal in a dry season, he charged in advance certain crimes and "pollutions" against the people, on account of which all his skill would be in vain. The more skillful rain-makers among the Sioux and the Mandans managed not to be among the beginners, but toward the last of the various contestants. The rain would surely come some time, and when it came the incantations ceased. The shaman who held the floor at the right time produced the rain.

Frequent reference to rain-making is found in the Old Testament, in which the prophets were the actors.

The mystery-men were consulted on all occasions as sources of truth, not only to explain dreams, but to disclose secrets of all kinds; to predict successes in war; to tell the causes of sickness; to bring luck in the hunt or in fishing; to obtain stolen articles; and to produce ill luck and disease. Their processes, together with thaumaturgic exhibitions, included some empiric knowledge, and also tricks of sleight-of-hand and hypnotic passes.

The Chahta had a peculiar mode of finding the cure for disease, by singing successively a number of songs, each one of which had reference to a peculiar herb or mode of treatment. The preference of the patient for any song indicated the remedy.

The Israelites believed that diseases as well as accidents without apparent cause, and other disasters, were the immediate acts of the elohim or were caused by evil spirits; therefore they relied upon prophets, magicians, or enchanters for exorcism. Hezekiah's boil was cured by Isaiah. Benhadad, King of Syria, and Naaman, the Syrian, applied to the prophet Elisha. All the people resorted to their favorite mystery-men.

Even so late as the time of Josephus it was believed that Solomon had invented incantations by which diseases were cured, and some handed down by tradition were commonly used. Incense banished the devil, which also could be done by the liver of a fish. Certain herbs and roots had the same power. Their medical practices might be recited, with slight change of language, as those of the Indians. The further back examination is made into savagery and barbarism, the more prevalent faith-cure appears.

Witches.—The Indians were in constant dread of witches, wizards, and evil spirits; but the activity of the good spirits was not so manifest. They, however, told Adair how they were warned by what he calls angels, of an ambuscade, by which warning they escaped. Bad spirits, or devils, were the tutelar gods of enemies, to be resisted by a friendly tutelar. The idea of a personal Satan was not found before the arrival of the missionaries.

Among the Indians witches were often indicated by the dreams of victims. They were sometimes killed merely upon accusation, and it is interesting to notice, with relation to comparatively modern history, that the accused frequently confessed that they were sorcerers, and declared that they could and did transform themselves into animals, become invisible, and disseminate disease.

A sufficient reference to the Israelites in this connection is to quote the ordinance, "Thou shalt not suffer a witch to live." This injunction, in the higher civilization, is observed by destroying the idea that witches live, ever have lived, or ever can live.

Dreams and Divinations.—The topics of inspiration by dreams and divination by oracles may be grouped together.

The Indians supposed that with, and sometimes without, a special fasting, and other devices to produce ecstasy, the spirits or daimons manifested themselves in dreams. It was sometimes possible in these dreams for the soul to leave the body, and even to visit the abode of departed spirits.

Among the Iroquoian tribes the suggestions made by dreams were implicitly followed, not only by the dreamer, but by those to whom he communicated his dreams. For instance, an Iroquois dreamed that his life depended upon his obtaining the wife of a friend, and, though the friend and his wife were living happily, and parted with great reluctance, the dreamer had his wish. The same tribe had a special feast which was called the "feast of dreams," and partook of the nature of Saturnalia. Every object demanded by the dreamers must be given to them. In some instances they were unable to remember their dreams, and the special interposition of the mystery-men was invoked to state what their dreams were in fact and what was their significance.

Among the invaluable reports of the Jesuit missionaries, one in 1639 gives the general statement that the Indians consulted dreams for all their decisions, generally fasting in advance; that, in fact, the dream was the master of their lives; it was the god of the country, and dictated their decisions concerning important matters—hunts, fishing, remedies, dances, games, and songs.

The belief in revelations through dreams was universal, and the power of explaining them was also by revelation. Their legends on this subject recall those about Joseph and Daniel. In addition, Job xxxiii, 15, 16, may be quoted:

"In a dream, in a vision of the night, when deep sleep falleth upon men, in slumberings upon the bed,

"Then He openeth the ears of men and sealeth their instruction."

And in Deuteronomy a prophet is equivalent to a dreamer of dreams.

There were various oracles among the Indians. Those most interesting to me are connected with pictography. Among many tribes, especially the Mandan, Hidatsa and Minnitari, after certain fasts and exercises, hieroglyphics deciding the questions which had been propounded appeared next morning on rocks. They were deciphered by the shaman who had made them.

The apparatus by which Jahveh was consulted was the urim and thummim, a form of oracle described as connected with the ark. It ceased to be known in the fifth century before Christ, and is now but vaguely understood. From the description and tradition it could, physically, have been worked by a custodian.

Severe fasts were probably the most common religious practices of the Indians. These were continued until they saw visions, sometimes sought for personal benefit as deciding upon their names to be adopted from the advent of a guardian spirit, and sometimes for tribal advantage. The doctrine of all of them, as Father Lafiteau quaintly observes, was the same that prevailed among many people of his day, to lead the mind from gross and carnal obstructions of the body. The real effect was to produce mental disorder. This ecstasy obtained by fasting was often accelerated by profuse sweating and the use of purgative or emetic drinks. Violent and prolonged exercise by dancing in a circle until the actors dropped in a swoon sometimes concluded the ceremonies.

The Israelite prophets were excited to inspiration by external means, such as dances and orgiastic proceedings resembling those of the dervishes and those of the Indian mystery-men. Music was a general accompaniment of the ecstasy. When they were about to prophesy, they wrought themselves into a condition of frenzy. When Elisha sent one of the children of the prophets to anoint Jehu, it was said of him, "Wherefore cometh this mad fellow?"

Pollution and Purification.—The subject of pollution and purification has been much and properly insisted upon as affording a striking parallel between the Israelites and the Indians. The Indians made special huts for the women, at certain periods, when they were considered so unclean that nothing which they touched could be used. A Muskoki woman, after delivery of a child, was separated from her husband for three moons (eighty-four days). This may be compared with the Levitical law by which the mother of a female child was to be separated eighty days and of a male forty days. Dr. Boudinot says that in some Indian tribes there was similar distinction between male and female children.

Among the southern Indians wounded persons having running sores were confined beyond the village, and kept strictly separate, as by the Levitical law. An Israelite dying in any house or tent polluted all who were in it and all the furniture in it, and this pollution continued for seven days. All who touched a corpse or a grave were impure for the same time. Similarly, many of the Indians burned down the house where there had been a death.

Many writers have asserted, as one of the excellences of the Israelite customs, that the "purification" imposed upon those who had been engaged in a burial was a sanitary regulation, a measure rendered expedient in a hot country. As no great proportion of the Israelites generally inhabited a country hot to the degree indicated, and as none of them had any conception of disease or the cause of death, this explanation is hardly sufficient. Much later the compilers might have gained some sanitary knowledge by which the old superstition was utilized. Its true explanation is from supernatural, not from natural, concepts. It is probably connected with a point mentioned before—i. e., the avoidance of corpses from the fear of the spirit of the dead and of the bad spirit which had caused the death, and the purificatory ceremony was for the daimon, not for the disease. The neglect of sanitation is well illustrated among the Navajo, who are little affected by civilization. Upon the death of one of their members they block up the shelter containing the corpse, and, from fear of the spook or of the agent of death, or of both, not from fear of the corpse itself, they never again visit it. Other tribes simply piled stones on the corpse, which prevented its disturbance by beasts, but did not absorb the effluvium. Still others exposed the dead on scaffolds. To leave corpses to putrefy freely is certainly not a sanitary measure, yet it was a practice existing together with the mortuary rites before mentioned, though many of the tribes practiced earth-burial, and a few used cremation.

On a broad examination of the topic of "pollution," so styled by most writers, it seems to be best explained by our recent understanding of *tabu*.

Sacrifice.—Man once imagined forces superior to himself, who yet could be invoked and moved to and from any purpose. The divine world was produced in his own image, and he treated its gods as he liked to be treated by his inferiors. He believed that the way to placate the forces surrounding him was to win them over as men are won over, by making presents to them. This clearly continued among the Israelites until the eighth century B. C., but it is to be regarded as a stage succeeding a former condition of zoölatry and totemism, without notice of which its details can not be understood.

Most people sacrificed to their divinities plants, fruits, and herbs, and animals taken from their flocks. People who had no domestic animals offered those taken in the hunt. The Indians offered the maize from their fields and the animals of the chase, and threw into the fire or water tobacco, or other herbs which they used in the place of tobacco. Sometimes these objects were hung up in the air above their huts. The northern Algonquins tied living dogs to high rods, and let them expire. In a similar manner other Indians stuck up a deer, especially a white deer, on poles. The plains tribes gave the same elevation to the head or skin of an albino buffalo on mounds, not having poles convenient. The spotless red heifer of the Israelites may be compared with the spotless white animals of the chase.

The southern Indians always threw a small piece of the fattest of the meat into the fire when eating or before they began to eat. They commonly pulled their newly killed venison several times through the smoke of the fire—perhaps as a sacrifice, and perhaps to consume the life-spirit of the animal. They also burned a large piece and sometimes the whole carcass of the first buck they killed, either in the winter or the summer hunt. The Muskoki burn a piece of every deer they kill.

The Israelites offered daily sacrifice, in which a lamb (except the skin and entrails) was burned to ashes. In some of their sacrifices there was not only distinction between animals that were fit and unfit, but in the manner of treatment. Sometimes the victim was not to be touched, but should be entirely consumed by fire. In others the blood should be sprinkled around the altar and the fat and the entrails burned, the remainder of the body to be eaten by the priests. But it was a crime to eat flesh that had been offered in sacrifice to a false god—i. e., god of another people.

The offering of the first-fruits, and therefore of the first-born, to the divinity, was one of the oldest ideas of the Semites. Moloch and Jahveh were conceived as being the fire, devouring whatever was offered to it, so that to give to the fire was to give to the god. In time, a substitute was suggested; the first-born was replaced by an animal or a sum of money. This was called the "money of the lives."

The "green-corn dance," common to many Indian tribes, is essentially the same ceremony of thanksgiving, or, more correctly, rejoicing with payment, for the first-fruits of the earth. Adair says that at the festival of the first-fruits the Southern Indians drank plentifully of the *cusseena* and other bitter liquids, to cleanse their bodies, after which they bathed in deep water, then went sanctified to the feast. Their annual expiation of sin was sometimes at the beginning of the first new moon in which their corn became full-eared, and sometimes at the recurrent season of harvest. They cleansed their "temple" and every house in the village of everything supposed to pollute, carrying out even the ashes from the hearths. They never ate nor handled any part of a new harvest till some part of it had been offered up; then they had a long fast "till the rising of the second sun." On the third day of the fast the holy fire was brought out from the "temple," and it was produced, not from any old fire, but by the rubbing of sticks. It was then distributed to the people.

Lafiteau says that the first animal the young hunter kills he burns with fire as a sacrifice. Another festival was a kind of holocaust, where nothing of the victim was left, but it was all consumed, even to the bones, which were burned. There were also feasts of first-fruits.

The Dakotas allowed no particle of the food at any of their religious feasts to be left uneaten. All bones were collected and thrown into the water, that no dog might get them or woman trample over them. It was a rule among many of the tribes that no bones of the beast eaten should be broken. There is no doubt that this was connected with zoölatry, and was intended to prevent anger on the part of the ancestral or typical animal, the result of which would be the disappearance of the game. There were many other ceremonies of the same intent. When the Mandans had finished eating, they often presented a bowlful of the food to a buffalo-head, saying, "Eat this," evidently believing that, by using the head well, the living herds of buffalo would still come and supply them with meat.

It is probable that what many authors have called the "day of atonement" or "expiation" was really a general wiping out of offenses—a settlement of accounts between individuals and particularly between clans, after which there should be no reprisal. This is illustrated by a peculiar ceremony among the Iroquois, strongly resembling the scapegoat of the Israelites. A white dog, before being burned at the annual feast, was loaded with the confessions or repentings of the people, represented by strings of wampum. The statute of limitations then began to operate.

In the Jahvistic version, the passover, an old festival held in the spring, was historically connected with the departure from Egypt. The ceremonies are too well known to require narration, but will readily be compared with those of the Indians.

Incense.—The use of incense among Indians was the same as among Israelites—i. e., to bring and to please the spirit addressed. A genuine instance among the Iroquois was where tobacco was offered as late as 1882, and in archaic formal language still preserved, translated as follows:

Address to the fire: "Bless thy grandchildren, protect and strengthen them. By this tobacco we give thee a sweet-smelling sacrifice, and ask thy care to keep us from sickness and famine."

Address to the thunder: "O grandfather! thou large-voiced, enrich and bless thy grandchildren; cause it to rain, so that the earth may produce food for us. We give this tobacco, as thou hast kept us from all manner of monsters."

The Dakotas not only burned tobacco in their "buffalo medicine" to bring the herds, but often fragrant grass. Other tribes burned the leaves of the white cedar. These forms of incense were sometimes used to entice the inimical spirits, the shaman being supposed to be able, when they had arrived in the form of a bear or some other animal, to kill them with his rattle. Some of the Indians believed that incense and sacrifices generally were to be used only for the spirits from whom they feared harm. They said it was not necessary to trouble themselves about the good spirits, who were all right anyhow.

Fetiches.—Among many of the tribes of Indians there is a tribal totem (and often several clan totems) which, in later times becoming chiefly symbolic and emblematic, was once used in objective form for the most important religious purposes. Particularly, it was carried on extensive warlike expeditions. Adair, who calls it an "ark," describes it as made of pieces of wood, fastened together in the form of a square, to be carried on the back. It was never placed on the ground, nor did the bearers sit on the earth even when they halted. In many other tribes it was a bag of skins and its contents varied, but generally were "blessed" or "sacred" fragments of wood, stone, or bone. Among the Omaha it was a large shell, covered with various envelopes, and was never wholly exposed to sight, for that would occasion death or blindness.

A custodian was appointed every four years by the old men of the Blackfeet, to take charge of the sacred pipe, pipe-stem, mat, and other implements, which he alone was permitted to handle.

The ark of the Israelites was probably derived from the Egyptians, who had a real ark which was carried on the shoulders of the priests in processions. When the exodus began, the Egyptian ark for convenience was changed into a chest fitted with staves for bearers. It became the standard of their warring and wandering life.

In addition to what has been called the ark or tribal fetich, the mystery-bag that each Indian had is to be compared with the Israelite teraph, which was a family or tutelary fetich independent of the national worship, and later was the subject of frequent denunciation. It was probably made of carved wood, and was often carried on the person, but was generally held as a household god or domestic oracle. The teraphim markedly resembled the Roman *penates*.

This comparison is explanatory of the statement that neither the Israelites nor the Indians worshiped idols. Its truth depends upon what is considered to be an idol. If the definition is limited to the human form the assertion is true, because their religion was not anthropomorphic; but fetiches were certainly the objects of worship, the recrudescent forms of which, appearing even in civilization, have been amulets, lucky-stones, pieces of wood and charms.

Sabbath.—It is not possible, in discussing the Israelites, to neglect the institution of the Sabbath. The four quarters of the moon made an obvious division of the month, and wherever the new moon and full moon are made religious occasions there comes a cycle of fourteen or fifteen days, of which the week of seven or eight days forms half. It is significant that in the older parts of the Hebrew Scriptures the new moon and the Sabbath are almost invariably mentioned together. Among the Israelites, and perhaps among the Canaanites, joy on the new moon became the type of religious festivity in general. There is an indication that in old times the feast of the new moon lasted two days, so that an approximation to regular recurrence of the subdivisions constituting the week was gained. The Babylonians and Assyrians had an institution dividing the month into four parts, by which, on the days assigned, labor was forbidden; but originally the Israelites' abstinence from labor was only incidental to their not working at the same time that they were feasting. While they were nomads, with only intermittent work, they had no occasion for a fixed day of rest.

The new moons were at least as important as the Sabbath until the seventh century before Christ. When the local sacrifices were abolished and the rites and feasts were limited to the central altar, which practically could be visited only at rare intervals, the general festival of the new moon ceased. The Sabbath did not, but became an institution of law divorced from ritual. The connection between the week of seven days and the work of creation is now recognized as secondary. The original sketch of the decalogue probably did not contain any allusion to the creation, and it is even doubtful whether the original form of Genesis distributed creation over six days.

Subsequent history of the Sabbath shows a reflex action between religion and sociology. Religion prevailed against better arrangements for periods of rest. Sociology used religion to get what it could.

The Indians reached only the first part of the inception of the Sabbath in the ceremonies of the new and full moon, which were to them of great importance, those of the new moon being most noted.

Circumcision.—This, generally regarded as a distinctive mark of the Israelites, is by no means peculiar to them, and is found in so many parts of the world, with such evidences of great antiquity, as to contravene its attribution to them. Its origin is a subject of much dispute. As practiced indiscriminately in infancy, it is perhaps a surgical blunder. It is certain that among the Israelites it was not at first a religious rite. The operation was not then performed by the priesthood, but by a secular person of skill, without ceremonials. Afterward it was regarded as an initiatory ceremony, and as such its parallels connected with the sexual organization may be found all over the world, but as a special national distinction the declared object was not attained. Besides the Egyptians, Arabs and Persians, with whom the coincidence might be expected, many tribes of Africa, Central and South America, Madagascar, and scores of islands of the sea, show the same mark, and it has even been found in several of the North American tribes. The sole motive for alluding to this very comprehensive subject is to correct the popular belief that the custom is peculiar to the Israelites. In this as in many other alleged respects they were not "peculiar."

IS THE HUMAN BODY A STORAGE-BATTERY?

By HYLAND C. KIRK.

HON. J. W. DOUGLASS, a lawyer of Washington, D. C., formerly Commissioner of Internal Revenue, after reaching his office one morning, to relieve the pressure on his foot, took off one of his new boots and sat at his work, his legs crossed in the customary legal form, his stockinged foot swinging freely. It happened to swing over the waste-basket, when, to his exceeding surprise, every piece of paper, string, and scrap in that receptacle, as if impelled by a writ of *habeas corpus*, rose up and clung to his foot. He brushed off the scraps and tried it again, and again that peremptory mandamus or process of attachment seemed to issue from his pedal extremity, and again the "poor white trash" of the waste-basket joined issue with the stocking. He was in a condition of excellent health and spirits that morning, and in a mood for experimenting: he removed his remaining boot, and secured a similar result with the other foot; when, congratulating himself on the fact that he seemed to be a very attractive person, he returned to his work.

An incident of this kind, though more startling in its outcome, is related as occurring in the same city more than eighty years ago, in a letter of a United States Senator, Dr. Samuel L. Mitchell. The letter is dated at Washington, March 17, 1802. He says: "A very singular occurrence has happened to General Dayton, of Elizabethstown, one of the New Jersey Senators. He pulled off his stockings of silk, under which were another pair of woolen gauze, just as he was going to bed. The former were dropped on the small carpet by the bedside, and the latter were thrown to some distance near its foot. Electrical snaps and sparks were observed by him to be unusually prevalent when he took off his stockings. He slept until morning, when the silk stockings were found to be converted to coal, having the semblance of sticks and threads, but falling to pieces on being touched. There was not the least cohesion. One of the slippers, which lay under the stockings, was considerably burned. One of the woolen garters was also burned in pieces—the carpet was burned through to the floor, and the floor itself was scorched to charcoal. It was a case of spontaneous combustion—the candle having been carefully put out, and there being very little fire on the hearth, and both of them being eight feet or more from the stockings."

Dr. R. D. Mussey, Professor of Surgery in Dartmouth College, in the "American Journal of Medical Sciences" for January, 1838, gives an account of a Mrs. B—, a married lady about thirty years of age, residing in Grafton County, New Hampshire, who gave out sparks and snaps continuously for some thirteen weeks, when this power was entirely lost and did not return again. The discovery of this faculty was a great surprise to the lady, and subsequently caused her some annoyance. Though Mrs. B— wore a silk dress at the time of the commencement of the phenomenon, this was exchanged for cotton and flannel successively without affecting the result; and the manifestations were found to be due to the lady's own person, and not to the clothing or other conditions. Dr. Mussey's account is supported also by Dr. W. Hosford, the lady's family physician.

Phenomena of this sort, when manifested, do not seem to be confined to any one portion of the human body, though occasionally localized. A Capuchin friar is mentioned by Dr. Schneider, whose scalp was a veritable reservoir of electricity. Whenever he removed his cowl a number of "shining, crackling sparks" would pass from his bald pate; and this phenomenon, which was definite and strong while the monk was in good health, continued perceptible after three weeks' illness.

The case of Angélique Cottin has been frequently referred to. She was a French peasant girl, fourteen years of age, and possessing excellent health at the time her singular powers were discovered. She resided in the Commune of La Perrière, department of Orne, and with three other young girls was engaged in knitting ladies' silk-net gloves. Suddenly the oak weaving-frame was thrown down. The girls put it up; and almost instantly it was again upset. It was soon discovered that, whenever the girl Cottin touched her warp, the frame was agitated, would move about, and then, without apparent cause, be thrown violently back. Subsequently chairs, tables, lighted fire-wood, brushes, books, tongs, shovels, scissors, and other metallic articles were all set in motion whenever this girl approached them. The girl was very imperfectly educated and her friends were of limited intelligence, so it was not remarkable that, in 1846, such phenomena should be attributed to sorcery. The case was investigated by a number of scientific gentlemen, including M. Arago, who were shocked, as well as startled, and gave surprising accounts of her powers. Some time after, however, she was taken to Paris and examined by the *savants* of the Academy, and nothing of a surprising character was discovered. She had simply lost the power she formerly possessed.

The manifestations of Miss Lulu Hurst, of Georgia, will be recalled. A tall, large-boned, well-developed, good-looking country girl, reared on a farm, without any knowledge of occult forces, and among people almost wholly uninterested in scientific subjects, suddenly seems to possess a peculiar force, and the furniture begins to manifest unusual qualities when Miss Hurst is present, phenomena occurring not unlike those attributed to the French girl of La Perrière. This power, which was considerable in the outset, gradually waned, until her public exhibitions were quite unsatisfactory.

The writer was one of the committee who, on her first appearance at Wallack's Theatre, New York, had opportunity to investigate Miss Hurst. One test was as follows: Three gentlemen, among whom was a professor of athletics, each using both hands, held a billiard-cue above their heads in the air; Miss Hurst, by placing her hands flat on the top of the cue, brought it down without apparent muscular effort. At that time all power of repelling articles without contact seemed to have left her; but her success in collapsing umbrellas held by a reporter, and in lifting and repelling chairs by lightly touching them, was quite extraordinary.

During these performances she kept up a low, nervous giggle, and did not seem especially fatigued at the close.

Other Georgia women developed similar powers about the same time, or shortly after Miss Hurst's peculiarity became known. Miss Mattie L. Price, living in the same neighborhood, was one of these, and Mrs. C. F. Coleman, wife of the superintendent of the Atlanta cotton-factory, was another.

These accounts all appear the more credible from the fact that an examination proves every human being, and in fact every animal organism, to be in some degree a producing battery of electricity. Du Bois-Reymond, Nobili, and Matteucci have, by numerous experiments, determined the existence of electric currents in the nerves and muscles; by means of delicate tests, Becquerel has detected electricity in the capillaries and other minute tissues; Engelmann, Volkmann, Hermann, and others, have experimentally determined something of the conditions under which various tissue-currents are manifested; and it is more than probable that this subtile fluid is being constantly generated in the processes of digestion, circulation, respiration, and secretion.

The electric fishes—the torpedo, the silurus, the gymnotus, and the ray—are the only animals, it is true, possessing a special apparatus for the production of electricity; yet the cell-structure and disks of their batteries have been developed from ordinary cells and tissues common to animal life. Other animals sometimes evince like powers. An acquaintance of the writer, some years ago, in California, came upon a splendid specimen of rattlesnake which he determined to capture. With a forked stick he succeeded in pinning his snakeship to the ground just as he had reached a hole. The snake seemed to be securely caught, but with a convulsive effort he not only entered the hole, but gave my friend an electric shock which he recalls as one of the strongest he ever received.

We are largely ignorant of the conditions necessary to the storage of this force in the human organism, but good health seems to be one. When their power is dissipated by repeated shocks, electric fish exhibit all the lassitude of weary human beings. The writer once handled a gymnotus, in Fulton Market, whose shock was hardly perceptible; yet, when vigorous, they are known to kill horses and mules by their powerful discharges.

It is said that any person in good health may convert his lower extremities into electric batteries, by wearing two pairs of silk stockings, preferably a black pair over white. After wearing them but a short time and removing them together, an attempt to separate the two colors will manifest a resistance of several pounds.

Atmospheric conditions have much to do with electricity in the body. In several cases, notably those of Angélique Cottin and Mrs. B—, of New Hampshire, this power was first discovered during the imminence of a thunder-storm. Human electrometers are sometimes met with. A young man named William Chapman, of Providence, R. I., was stunned by the shock of a stroke of lightning which struck his father's house. The current passed through his body and went out at his right heel, which was painful for some time afterward. On every occasion of a thunder-storm since then he feels, hours before the time, a tingling pain in the heel. Young Chapman would be a valuable acquisition to the Signal Service as a portable electrometer, and, if he can do as well as he is said to have done on certain occasions, he would be ahead of any device that science has yet lighted upon to foretell an electrical storm.

A remarkable instance of the salutary effects of atmospheric electricity on the human body is told by the Wolverhampton correspondent of the London "Times." He states that during a thunder-storm a collier named Bates, who had lost his sight through an accident, was being led home, when a flash of lightning was reflected on the spectacles he was wearing to conceal his disfigurement. After the peal of thunder which followed he complained of pain in his head. The next moment, to his surprise, he found that he had regained possession of his eye-sight. The occurrence caused considerable excitement in the locality.

Since the date of Galvani's discovery, there have been many persons sufficiently bold to assert the identity of electricity and life. Even before that period, the observance of electric phenomena in man had been a subject of popular interest. In his "History of Electricity," Priestley relates that drawing a spark from a living body "makes a principal part of the diversion of gentlemen and ladies who come to see experiments in electricity." Doubtless the diversion was not lessened by the fact that the "electrical kiss" was a favorite form of the experiment.

The excitement in Paris, Edinburgh, and other cities, following the application of galvanic electricity to dead bodies, was of a very startling character, many supposing that the secrets of life were about to be yielded up by this wonderful *fluid*. Bonaparte, it is said, after witnessing experiments in voltaic electrolysis, remarked to his physician, Corvisart: "Here, doctor, is the image of life; the vertebral column is the pile, the liver is the negative, the bladder the positive pole." Though much has been discovered since that statement was made, but a modicum of the truth probably is known.

Perhaps the developed man of the future, in his physiological relations to the universe, may exemplify the magnet, whose forces are exerted constantly as received without seeming detriment to its substance.

RESPONSIBILITY IN MENTAL DISEASE.*

By Sir JAMES CRICHTON-BROWNE, M. D.

I CAN not pretend to summarize what has been written or said about insanity and crime during the last forty years, or a fourth of that time. All that I propose is to submit a few observations which have occurred to me on the following points: (1) on the insufficiency of the definition or test of insanity at present accepted and acted on in courts of law in this country, and on an amended test which would commend itself to medical experience; (2) on the value of expert testimony in establishing the existence and nature of insanity in courts of law; and (3) on a practical step toward the reconcilement of medical and legal differences of opinion on questions of insanity and crime.

What is the law of England with reference to insanity as an excuse for crime, and how far is that law reasonable and in accord with the conclusions of medical science? As to what the law is, there can not be much doubt, for every judgment delivered in cases in which the plea of insanity has been set up since 1843 has been founded on the answers then returned by the judges to the questions put to them by the House of Lords during the ground-swell of the McNaghten case. The gist of these answers runs: "That to establish a defense on the ground of insanity, it must be clearly proved that at the time of committing the act the accused was laboring under such a defect of reason from disease of the mind as not to know the nature and quality of the act he was doing, or if he did know it that he did not know he was doing what was wrong." Now, it is obvious that under this ruling, if I may call it so, are included a large number of cases of insanity. Under it would stand excused the raving maniac who does not apprehend the nature or quality of any act, the idiot who is in the same predicament, the fatuous person who can not foresee the consequences of his acts, and the victim of delusions, when these are of such a character as would justify homicide were they beliefs entertained by a sane man. But it is, and always has been, equally obvious to medical men that this ruling excludes a considerable proportion of cases of insanity in which moral as distinguished from legal irresponsibility exists, and that it is faulty in founding the test of insanity on knowledge or an intellectual state while it ignores states of the emotions and will, which are always more influential on conduct than intellectual states, and bulk far more largely in insanity. The test of insanity which commends itself to medical men was never more clearly and succinctly expressed than by Lord Bramwell when in the Dove case he asked, "Could he help it?" Could he or she help it? That is the real practical question at issue in every case in which the defense of insanity is set up. Was the lunatic free to choose, or under the duress of disease? Was his will incapable or inept? But Lord Bramwell and those who think with him argue that it is sufficiently proved that the lunatic could help it if he knew the nature of his act—viz., that it was killing; the quality of his act—viz., that it was a crime; and also that it was wrong in the sense of being forbidden by law. Whereas medical men, almost without exception, maintain that a lunatic may be able to know and express the nature and quality of an act and its wrongness, and yet be as unable to resist doing it as he is to abstain from jumping under a smart electric shock; and that knowledge of the nature and quality of an act and its wrongness is not in the regions of pathology any measure of will-power. And not only medical men, but judges, have perceived this. The late Lord Chief-Justice Cockburn said, "The power of self-control, when destroyed or suspended by mental disease, becomes, I think, an essential element in the question of responsibility." And Mr. Justice Stephen has said, "It ought to be the law of England that no act is a crime if the person who does it is at the time when it is done prevented by defective mental power, or by any disease affecting his mind, from controlling his own conduct, unless the absence of the power of self-control has been produced by his own default." This statement of the law, which has been verbally amended by Dr. Bucknill, really covers all that medical men have ever contended for, and, having received it from so high an authority, it is their duty to do their best to secure its acceptance, and provide trustworthy tests of loss of self-control.

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* Abridged from a lecture delivered to the College of State Medicine.

Now, impairment of will, or loss of self-control, more or less pronounced, is, according to medical men, the first, last, and universal element in insanity, and ranges from a trifling reduction in the check-action which we exercise on the ordinary currents of thought and feeling down to paralysis of the sphincters. Dissolution—and insanity is dissolution—implies a reversal of evolution, and in insanity we have, as Dr. Hughlings Jackson has taught us, a process of undevelopment, or taking to pieces, in the highest centers, which are the crown or climax of nervous evolution. In it we have "a descent from the least organized, most complex, and most voluntary, toward the most organized, most simple, and least voluntary." There is in every case of insanity impairment of voluntary control, and as a consequence of this there is more or less license given to those lower mental functions which are during sanity under voluntary control, and which become then overactive, their overactivity being expressed in delusions, hallucinations, wild and whirling words, and extravagant actions.

When our attention is withdrawn—as, for instance, when we have dropped into a reverie or are just falling asleep—a sound that might have made us turn our heads, if on the alert, will cause us to start violently; and when in insanity volition is impaired, sensations that would have been almost unnoticed in health stir up morbid feelings. Did time permit, I think I could establish that affinitive sights, sounds, smells, tastes, and surface impressions, as well as organic sensations, play a larger part than is generally supposed in the induction of morbid impulses when the regulating brain-centers are weakened. Many sane persons have experienced horrid promptings when standing looking over a precipice or gazing at a passing train, and among the insane the glitter of a knife or the crackling of a fire will sometimes evoke suicidal or homicidal impulses which but for it might have remained dormant.

Will is the link between feeling and action, and when it is impaired it ceases to be available to prevent the transmutation of the energy of feeling into the energy of motion. And here we have an explanation of the utter inadequacy of the motives that constantly lead to insane crimes. There is no check-action; there is an abbreviation of that pause that gives time for foresight and reflection. "Must give us pause!" says Hamlet when on the brink of suicide—time to summon up the forces of rational resistance. Man is a hesitating animal. The whole system of Zoroaster hinges on the fact that everything noxious and evil in creation is the work of Ahriman, an independent power, whose wickedness depends on the fact that he acts before he thinks; whereas Ormuzd, the good spirit, thinks before he acts. And madmen may in many instances be distinguished from sane men in the same way. The impulsive madman acts before he thinks; feeling is translated into action with reflex precipitancy, with an abbreviation of that time interval between stimulus and response which can now be subjected to experimental measurement; in the absence, therefore, of all restraining considerations, and in a violent and disproportionate manner. I have known an epileptic to kill his attendant, beating his head into jelly, because he had prevented him from taking his daily walk. I have known another epileptic hang himself because a smaller portion of bread and butter had been served out to him than to his companions; and, in the recent case at Weston-super-Mare, the lad Hitchins shot his sister because of some trifling slight which she had put upon him. In all such cases a momentary irritation, a natural feeling of chagrin, such as we all feel when thwarted or disparaged, instead of being inhibited in its nascent state when inhibition is most powerful, so that the reaction to it may be reduced by deliberation to rational proportions, is, by the diminished resistance of the will and the consequent overaction of the lower centers, permitted to become fixed or to express itself in a grossly exaggerated manner.

That voluntary power is invariably impaired in insanity is not perhaps evident to those who have not looked closely into the matter. Is it not true, it may be asked, that some insane persons exhibit extraordinary fixity of purpose and persist in some course of conduct—as, for example, the refusal of food with dogged obstinacy? That is so, but insane obstinacy is no more an indication of voluntary power than is the late rigidity of a paralyzed arm. That state of late rigidity in which the arm could not be stretched without being broken betokens that certain lower centers have been cut off from intercourse with higher ones and are undergoing degeneration; and so the unreasonable obstinacy of lunatics in insane conduct merely indicates that certain mental functions have escaped the regulation of volition, which is enfeebled, and are acting in an irregular and self-willed manner in consequence.

No doubt in all cases of insanity a certain amount of volitional power is retained, and this may in certain cases be effectual to some extent over the morbid mental manifestations. There may be contributory negligence on the part of a lunatic, just as there may be on the part of an invalid. Prof. Rühle, of Bonn, recommends the birch-rod and shower-baths in certain cases of chronic vomiting, and asserts that children often die of a bad bringing up, and adults because they can not, when ill, make up their minds to do what is right and omit what is hurtful; and Niemeyer quotes with approval the dictum of the wife of a Prussian general, a most determined woman but a tender mother, that whooping-cough is only curable by the rod. But no one in this country would now sanction such heroic treatment, or believe that anything but evil could come from such stringent appeals to a mere remnant of will in its corporeal relations; and so it would be dangerous in cases of insanity, in which will is obviously and seriously involved in its mental relations, to infer that what survives of it might, if put forth, have prevented a criminal act. In insanity, in which the mental movements are typically involuntary, but yet susceptible of some control, we must not expect of the patient what is beyond his strength—the habitual suppression of his morbid impulses. The criminal act of a lunatic is sometimes so alien to his healthy disposition, or so clearly motiveless, that we have no hesitation in concluding that his true will must have been in abeyance when he fell into it. At other times it follows upon mental struggles which he has himself described, and asked help in, previous to its commission, and is therefore clearly but the climax of a pathological process signifying the overthrow of the will. And at other times, again, it is associated with mental and bodily symptoms which, our experience has taught us, correspond with complete paralysis of will.

A lunatic may unquestionably commit a crime under ordinary motives. It can not be contended that every mental oddity and isolated delusion is to put a man beyond the pale of the law, but it is to be remembered that a really isolated delusion is a rarity, and that most delusions are but local manifestations of a constitutional vice, involving weakening of will. Most lunatics are, it has been said, mad to their finger-tips; and what appear to be their sane acts are generally more or less tinctured with insanity.

I can not pause here even to sketch the several stages of mental dissolution, but I would suggest that there are practically three levels of these in connection with lunatic crime. They are—the ideational level, the impulsive level, and the automatic level. On the first, the ideational level, the criminal act is committed under the influence of an insane motive or a delusion or hallucination, with consciousness at the time and remembrance afterward of all that has taken place, but in consequence of a diminution of inhibitory or resisting power. On the second, it is committed under the stress of a sudden and irresistible impulse, which is often a reversion to a mere animal instinct, with vague or imperfect consciousness at the time, obscure remembrance afterward, and under a still more grave paresis of inhibitory power. On the third, it is committed under the influence of accidental or reflex suggestion, without consciousness at the time or remembrance afterward, and during the complete abrogation of inhibitory power. As illustrations, I may mention on the first level the case of a man who kills his friend with elaborate preparation to spare him suffering, because he has been told by the archangel Michael that the death of that friend is necessary to the extinction of Freemasonry, which is the curse of the human race, and who afterward describes the homicide in detail, and with evident pride and satisfaction; on the second level, the case of a puerperal woman, who, seeing a glittering knife by her bedside, suddenly cuts her baby's throat, without afterward having any clear recollection of the event or being able to say why she did it, although the knowledge that she had done it fills her with grief and remorse; and on the third level, the case of an epileptic, who, while recovering from a fit, kills whoever happens to be nearest to him, while still unconscious, and who retains afterward no trace of recollection of the tragedy.

It seems to me that nothing has more retarded an approach to a just appreciation of the relations of responsibility and disease than the assent, tacit or explicit, generally given to the dogma that the existence of insanity is a question for men of common sense—a question which they are quite as capable of deciding as medical men or experts. The late Lord Shaftesbury, who, by his philanthropic labors, conferred such signal benefits on the insane, did some disservice to medical jurisprudence when he lent the weight of his authority to this doctrine, and maintained that "persons of common sense, conversant with the world, and having a practical knowledge of mankind, brought into the presence of a lunatic, would in a short time find out whether he was or was not capable of managing his own affairs"; and the late Sir Benjamin Brodie erred, I think, still more grievously when he said: "It is a great mistake to suppose that this is a question (unsoundness of mind) which can be determined only by medical practitioners. Any one of common sense, and having a fair knowledge of human nature, who will give it due consideration, is competent to form an opinion on it; and it belongs fully as much to those whose office it is to administer the law as it does to the medical profession."

Now, it may be admitted that there was a time when medical science was in its infancy, when the functions of the brain were unknown, and when only metaphysical explanations of insanity were attempted, at which the existence of insanity in any given case might have been as correctly determined by plain, unsophisticated men as by pretentious empirics. Further, it may be granted that there are an immense number of cases of insanity in which the symptoms of the disease are so obvious and external, that special skill, although requisite to interpret these symptoms, explain their causes, predict their results, and prescribe treatment, is not necessary to their identification. But, beyond all this, there are, it must be maintained, cases of insanity of so obscure and subtle a nature that they can only be properly identified by those who have made themselves intimately acquainted with the functions of the nervous system in health and disease, and who have by experience come to appreciate the significance of combinations of mental phenomena and of concomitant bodily variations, which would appear meaningless to the uninitiated.

The fact is, that practically the utility of expert testimony in insanity is acknowledged, and it is difficult to understand how it could be otherwise, for all who have made only a superficial study of mental diseases must perceive that there are in them little signs and symptoms, perversions of thought and derangements of bodily functions, which would altogether escape the notice of common sense, but warrant an expert, founding on his experience, in proclaiming that the will is reduced to impotency, and that the lunatic can not control himself. There is something in the appearance, manner, and mode of expression of lunatics of various classes which would pass unnoticed by common sense, but be characteristic to those who had been accustomed to watch them narrowly. There are styles of morbid thought which can not be imulated. There are latent or concealed delusions which start nto view when the appropriate spring is touched. There is the rder in disorder of dissolution which can not be imitated. There re types of delusions and hallucinations which are easily recognized. And, above all, there are physical signs of disorder of the brain and nervous system which correspond with certain stages in the degradation of will-power.

To the expert witness in cases of insanity and crime these questions should, it seems to me, be put: Was the prisoner insane at the time when he committed the act of which he is accused? Was his insanity of such a nature and degree as to deprive him of control over his conduct? What are the grounds upon which you have formed these opinions? It would then remain for the jury, aided by the judge, and with the assistance of other experts if necessary, to decide on the validity of the grounds stated and on the weight to be attached to the opinions expressed.

Expert testimony, to be of the highest value, ought of course to be founded on an examination, or, better still, on repeated examinations, of the accused, made as soon as possible after the perpetration of the crime. But insanity is a chronic disease; and even when the expert has not seen the alleged lunatic until some time after his crime, he may still be able to say whether in the course of a disease still existing, or of the recent existence of which there are traces, such a criminal act was likely to crop up as part and parcel of the disease; and whether it is consistent with his experience and with the history of the act that the accused could not help it. When the crime was committed during a temporary paroxysm of madness or during an attack from which recovery has taken place before the examination has been ordered, it may still be possible for an expert to say whether the symptoms described to him form a true picture of mental disease or are only a spurious copy, and whether any wreckage still marks the course of a nerve-storm. Sometimes it will be impossible for an expert to make up his mind either one way or the other, and then it is his duty plainly to say so.

And now I have a practical suggestion to offer which would, if adopted, I venture to believe, do more to reconcile the great professions of law and medicine on the questions at issue between them respecting insanity and crime than any prolongation of those elaborate and sometimes highly spiced logomachies in which they have both indulged in the past.

What is wanted is a series of skilled and sustained observations on homicides who have escaped punishment on the plea of insanity, made by competent and unbiased authorities, couched in language understanded of the people, and published from time to time. And, in order that such a series of observations may be pursued, I would propose the appointment of a committee or commission, composed in equal parts of lawyers and medical men, whose duty it should be to visit the asylums as often as they might deem expedient, to examine individually all patients detained there who have been charged with murder, and also the officers of the asylums, and their case-books and registers, and to report annually on the mental condition of every such patient, with special reference to the circumstances of the crime of which he or she was accused, and the evidence adduced at his or her trial, adding such remarks on the relations of insanity and crime, and such recommendations for alterations of the law, as their experience may suggest to them.

Looking forward to such reports, the faithful scientific witness would speak with confidence, assured that his evidence, although it might appear strained at the time, would be confirmed by events; while the pseudo-scientific witness, if there be any such, who is led into the box by a thirst for notoriety or a spurious philanthropy, would pause before committing himself to statements which might rise up in judgment against him in a very damaging and persistent way. And there can be no impropriety in alleging that such reports would ultimately prove useful to judges and counsel.

Beyond this, the deliberations of such a commission would conduce in some degree to an agreement between lawyers and doctors on the question of insanity and crime. It is in the atmosphere of the courts of law that differences between them spring up, differences which in private conference speedily dwindle away. It is about theoretical definitions and verbal distinctions that they contend; and wherever they are brought together in actual contact over a case anywhere save in a court of law, the lawyers with striking aptitude adopt the scientific standpoint, and harmony results.—*The Lancet.*

THE LUCAYAN INDIANS.

By Prof. W. K. BROOKS,
of Johns Hopkins University.

IN three years the world will unite in celebrating the four hundredth anniversary of what, from our point of view, is the grandest and most important event in history, the landing of Columbus; but in our consciousness of its profound significance, are we not in danger of forgetting that the Spaniards *discovered* America in the way that pirates discover a vessel with a helpless crew?

While no one can doubt that the world, as a whole, has been benefited, there is reason to question whether any of the islands which Columbus himself discovered have profited by the change.

Hayti is almost completely in a state of revolting and hopeless savagery, and recent writers assert that Jamaica is rapidly traveling the same road. The condition of Cuba is by no means encouraging to her friends; and in the Bahamas, abandoned homesteads, costly villas tumbling to ruins, roofless walls, and fields and plantations converted into tropical jungles, testify to anything but prosperity. The population of the Bahamas is less to-day than it was on the day Columbus landed, and it is not increasing.

He found the Bahamas in the possession of a prosperous and happy people who called the islands the Lucayas, and themselves Ceboynas. Twelve years afterward every soul of this population of more than forty thousand men, women, and children had perished in a strange land under the lash of the slave-driver; the race was blotted off the face of the earth, and the only impression which has been left upon our civilization by those who first welcomed it to this continent is a single word, which, together with the luxurious article it designates, has spread over the whole earth. The Ceboynas gave us the hammock, and this one Lucayan word is their only monument.

Nowhere in all the black pages of history is there a darker tragedy than theirs; and while it is eminently proper that we should pay all homage to the transcendent genius and noble nature of the great admiral, and that we should celebrate with all pomp and pride the miraculous growth of our own civilization, does it not also become us to commemorate in some way, at the same time, the story of the unhappy and forgotten Ceboynas, to whom the discovery had a still more profound significance?

How intensely interesting, just at present, is any addition to our knowledge of the other party to the transaction! The writer has recently spent two seasons in zoölogical research in the Bahama Islands, and has been able to learn a few facts, which are new to the science of anthropology, relating to the bodily structure of the long-lost Ceboynas, and thus to contribute toward the perpetuation of their memory.

There is not much intrinsic interest in a few fragments of human bones, but the Ceboyna skull which stands upon my table as I write gives life and vivid reality to the familiar story in the first chapter of my school history, and calls up in all its details with startling clearness the drama of the Bahama Islands.

To most of us these islands are little more than dots upon the map, but, small and sterile and unimportant as they are, they form one of the fairest landscapes upon earth, for they present all the conditions which are most favorable for intensity of color of earth and sea and sky. Under the combined influence of white soil, intense sunlight, and perfect purity of air and water, they glow with the sparkling colors of jewels. The hot air is loaded with moisture to the saturation-point, like that of the deep, shady recesses of a rocky glen on the edge of a waterfall; but the islands are also as wind-swept as a mountain-top, and the air is absolutely pure, for the ocean breeze brings with it no smoke nor dust, no pollen nor vegetable refuse, nor anything whatever except pure, moist, warm air. As the saturated sea-breeze blows over the thousand islands of the archipelago, the slight difference between the temperature of the changeless ocean and that of the variable land, which heats quickly in the daytime and cools quickly at night, manifests itself by the formation of great, snow-white banks of summer clouds which are as characteristic of the Bahama horizon as the water itself or the deep, pure blue of the sky between the clouds.

The islands stand on the extreme edge of a submerged abyss where the surface falls as suddenly and to as great a depth as it does from the summit of the Andes, and the unfathomable water of mid-ocean is only a few miles away. Some of the out islands are only two miles or so from water more than two miles deep, and the currents which sweep through the sounds and around the islands at each turn of the tide are absolutely pure, and they have the intense color which is found in mid-ocean, or the melted ice of glacial lakes, or in the center of the rocky basin of Lake Superior. In great depths this color is a pure, vivid sapphire blue, darker but more transparent than the blue of the sky. In the shallow sounds, where the intense sunlight is reflected back from the chalky bottom, it glows like a surface of beryl with an intense green lustre totally unlike anything which is met with in other waters, although the center of the Horseshoe at Niagara would be very similar if it plunged over a ledge of white marble under the light of a tropical sun. All these influences combine to give a degree of intensity and vividness which can not exist in a continent to all the colors of a landscape which is wrapped in perpetual spring. Under their dome of blue sky and snowy clouds the Isles of June, in their setting of sapphire, are buried under a mantle of verdure so dense and luxuriant that the vegetation thrives as if in a hot-house, and, abandoning the rocky and sterile ground and contenting themselves with the warm, moist sea-breeze, not only the mosses and ferns and orchids and bromeliads, but large trees as well, grow tier above tier, climbing over each other's heads in their efforts to escape the struggle for existence and to obtain air and sunlight and standing-room.

Who can wonder that, when Columbus found himself in this enchanted fairy-land after the changeless monotony of mid-ocean and all the anxieties of his long voyage into unknown waters, he should have been most profoundly impressed by its beauty, for nowhere on earth can we find a fairer land than these Isles of June. The exciting occupations incident upon his arrival left him little time for writing, but he faithfully jotted down day by day in his log-book in short, crisp sentences which even now are full of graphic interest, the impressions which were still fresh upon him. The United States Coast Survey has recently done good service to history by the publication of an English translation of this rare and almost unknown document, and the extracts in this paper are from this translation. After he set sail on the second day, he says that he saw so many islands that he could not decide to which one he should go first, and the men he had taken told him by signs that they were innumerable. On the fifth day he writes of the island which he named Isabella: "There was in it twelve leagues, as far as a cape which I called Cape Beautiful, which is in the west, and so it is beautiful, round, and very deep and free from shoals: at first it is rocky and low, but farther in it is a sandy beach, as it is along most of our coast. The island is the most beautiful thing I have seen; if the others are very beautiful, this is still more so; it has many trees, very green and very large, and this land is higher than that of the other islands I have discovered, although it can not be called mountainous. Yet gentle hills enhance with their contrasts the beauty of the plain, and there appears to be much water in the middle of the island. Northeast of this cape there is an extensive promontory, and there are many groves very thick and very large. I wished to anchor off it in order to land, and visit so handsome a spot, but it was shallow and I could not anchor, except far from land, and the wind was very favorable to come to this cape, where I am now anchored, and which I have called the Cape Beautiful because it is so; and so I did not anchor off that promontory, because I saw this cape so green and so beautiful, as are all the other things and lands of these islands, so that I do not know to which to go first, nor do my eyes grow tired with looking at such beautiful verdure; and when I reached this cape the odor came so good and sweet from flowers or trees on the land, that it was the sweetest thing in the world."

Of the Island of Fernandina, he says (October 16th): "The island is very green and level, and exceedingly fertile. . . . I saw many trees whose shape was very different from ours, and many of them which had branches of many kinds, although all growing from one trunk, and one branch of one kind and another of another kind, and so different that the diversity of the kinds is the greatest wonder of the world—for instance, one branch had leaves like those of cane, and another like those of a mastic: and thus on a single tree there were five or six of these kinds, and all so different; nor can it be said that they have been grafted, because these trees grow wild in the field and nobody cares for them.

"The fishes here are so different from ours that it is a wonder. Some look like cocks of the finest colors in the world, blue, yellow, red, and all colors, and others variegated in a thousand fashions; their different hues being so exquisite that nobody can contemplate them without wondering, and feeling great delight in seeing them. There are also whales here; but on shore I saw no beasts whatever, save parrots and lizards."

Columbus found all these islands much more thickly inhabited than they are to-day, by a race of people who called themselves Ceboynas, although his misconception as to the nature of his discovery led him to bestow on them the name by which all the aboriginal inhabitants of this continent are now known.

As they had very few artificial wants, and were able to live without forethought or care in a land which knows no change of seasons, where the harvest ripens without attention, and a tempting fish for the day's dinner can be picked out and speared as if it floated in the clear water of an aquarium, they were totally ignorant of much that the Spaniards regarded as essential for man, and Columbus, mistaking simplicity for destitution, makes the entry in his log-book that he "thought them to be a very poor people." It is true that, except for the "one who wore in his nose a piece of gold of the size of half a castellano, on which were letters," he found no indications of the wealth of India; but before he had been a week in the New World he discovered three luxuries which have been warmly welcomed by the whole civilized world.

On the third day he enters in his log that "the men I sent for water told me that the houses were well swept and perfectly clean, and that their beds and coverings looked like cotton nets, which they called *hamacas*"; and within a few days, as he extended his explorations to the neighboring Antilles, he met with cigars and chocolate. Poor the Ceboynas might be in the matter of useless clothing and arms, but a race which could doze idly in hammocks, under the blue sky, in the warm sea-breeze, idly puffing their Havana cigars, as they gazed out on to the flashing water and waited for their crops to ripen, were not completely destitute and squalid. Civilized man might well covet even a harder life than that of the natives of the lovely Lucayan Islands before the discovery, but every school-boy knows the rude awakening which the peaceful Ceboynas soon received.

Two years ago I enjoyed the delights of a long cruise, in the schooner which carries the mails, through the calm, landlocked sounds which thread in all directions the mazes of the archipelago, and the gentle but unfailing breeze bore me on day after day, while new beauties rose up and unfolded themselves before me as the islands I had passed dropped down toward the horizon behind me and faded away, until there stole over me the feeling that the whole might be some fairy landscape traced by fancy in the summer clouds, and that if I closed my eyes for a minute I might find it all dissolving into air.

As I passed the little inlets, with their lines of white breakers, and beyond them the deep blue of the open ocean fading in the distance into the lighter blue of the sky; or, as I leaned over the rail while the vessel slipped on as if it were hung in mid-air; as I watched the gaudy fishes darting over the white sand many fathoms below, or caught glimpses into the deep dark caves between the great, dome-like coral-heads which swept up in smooth curves from the depths almost to the surface, and overhung cool grottoes hung with gorgeous anemones and sea-fans and sea-feathers, among which innumerable animals in an endless diversity of strange forms could be dimly seen as the vessel slipped by; as I drifted on day after day, and passed one charming spot after another, only to find still more beauty beyond, I could not escape the thought that in this enchanted land of beauty which no brush could paint, where every prospect pleases, man has been unutterably vile, and this not the heathen in his blindness, but the conqueror who, as old Bernal Diaz quaintly but frankly puts it, "Took his life in his hand that he might give light to them who sit in darkness, and satisfy the thirst for gold which all men feel."

Less than fifteen years after the discovery the forty thousand Ceboynas were gone, and the Lucayas were left desolate. For nearly two hundred years every one of these thousands of lovely islands was abandoned to the parrots and lizards, and, except for the visits of Ponce de Leon, in his search for the magic fountain, and an occasional English sailor, no boat moved through these quiet sounds; until at last the peaceful islanders who, as Coumbus writes to Queen Isabella, were the best people on earth, and loved their neighbors as themselves, were replaced by a new population, and the banner of the Jolly Rodger gathered here, from the ports of Europe, the worst human scum which civilization has ever produced. Who could cruise through this earthly paradise without meditating upon the fruit of our civilization as it has here developed itself?

While Columbus had none of the vices of lesser men, he felt bound to fulfill his promise to enrich those who had aided him; and on his first Sunday, October 14th, only two days after his landing, the gentle influences of the Sabbath in this strange and beautiful land moved him to commit his impressions to writing, and, while his pen overflows with the delights of the New World and the loveliness of the people, he enters in his log that he is keeping a keen watch for a place to build a fort; for, he says, "Inasmuch as the people are perfectly defenseless, and totally unacquainted with arms, a force of fifty men could keep them captive in their own island and make them do whatever might be desired," in case the king might not wish them all taken to Spain as slaves.

As he found no gold, except the nose-ornament, worth about a dollar and a half, which the owner refused to barter for glass beads, Columbus soon left the Lucayas, and for a few years they were forgotten. By an accident hardly less probable than the discovery of a new world, he soon actually found rich gold-mines in Hayti; and for a time the Spaniards forgot their desire to give light to them who sit in darkness, in their eagerness to slake their thirst for gold. They did not, however, forget the cotton nets of the Ceboynas, and they soon discovered, as all white men in the tropics do, that it is much easier to lie in a hammock puffing a cigar, and to sip chocolate as the days slip by, than to dig for gold, and they then bethought themselves of their duty to enlighten the darkness of the heathen natives of the Lucayas.

The king at once perceived the importance of bringing these people under Christian influences, and in 1509, or less than eleven years after the discovery, he issued an order for the deportation of the whole population of the Lucayas to New Spain, and the work of conversion was at once vigorously instituted with the aid of blood-hounds.

For a time the Spaniards seem to have regarded the Antilles as an inexhaustible slave-quarry, and to have thought it cheaper to replenish their exhausted stock of slaves than to care for those they had. They soon found, however, that it was not so easy as Columbus had thought to make the Ceboynas "do whatever might be desired"; and while the people who had never labored for themselves were powerless to escape slavery, they resisted to the death all the efforts of the Spaniards to profit by their labor.

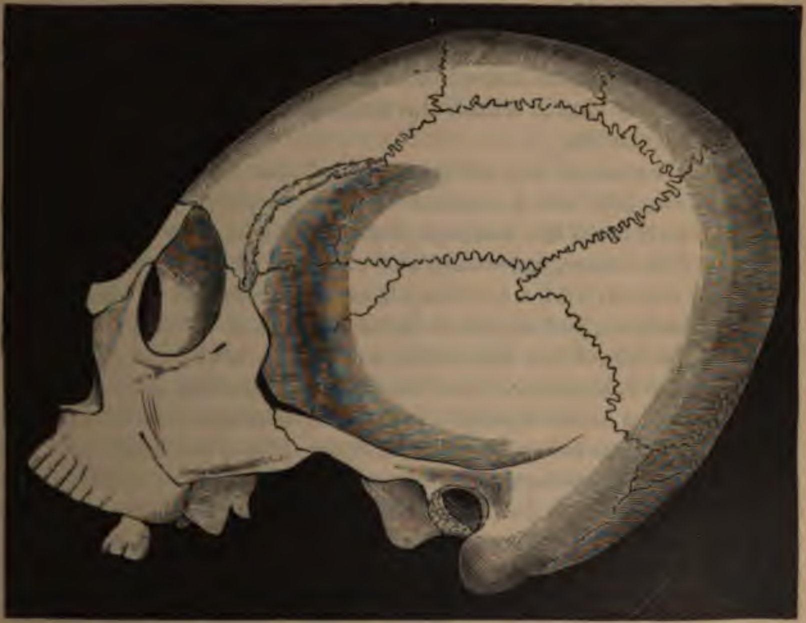
So relentless were the conquerors, and so determined and hopeless the captives, that the unhappy slaves perished by wholesale in the mines of Hayti, under the lashes of their drivers and the steel swords which were often broken over their obstinate heads; and even now the mind recoils from the contemplation of the few facts regarding the fate of the Lucayans which history has preserved.

As an illustration, Las Casas gives, among others, the case of one Spaniard who, three months after he had received three hundred Lucayan slaves, had less than thirty left alive. For a short time this destruction was made good by fresh importations, but the supply was soon exhausted. All the islands were left desolate, and the Lucayan race was as if it had never been. The hammock, the first gift of the New World to civilization, is their only monument, and the word the sole remnant of their language.

Columbus says that, on Saturday, October 13th, the second day, "A great crowd came, each bringing something, giving thanks to God, and entreating or beseeching us to land. We understood that they asked us if we had come down from heaven"; and before the children, who were led to the beach to welcome the celestial visitors who had been borne to them on white wings out of the blue dome which bounded their world, had grown to manhood, they perished, with all their race, in a foreign land.

Where shall we find a sadder story than this? The evil was done long ago; there is now no remedy; but as the recollection thrills our pulse, and our generous sympathies are awakened, how eagerly do we ask the question: "What manner of men were the Lucayans? What were they like?"

These questions I am now able to answer, at least imperfectly, and the skull which is here figured once belonged to a person who may possibly have been among those who welcomed Columbus.



Like all coral islands, the Bahamas abound in caves, and these were used in some way by the Ceboynas, perhaps as burial-places, possibly as refuges from the blood-hounds of the Spaniards. The floor of these caves consists of red clay, rich in phosphates and of commercial value, and within recent years it has been removed from most of them and sold. During the excavations many human bones and other relics were found, but they attracted little interest, and most of them were destroyed. I learned, however, during a recent visit to the islands, that a few of the bones had found their way into the hands of thoughtful and intelligent persons, and had thus been preserved. Their custodians at once appreciated my desire to study them, and generously placed them at my service for this purpose, so that I was able to obtain notes for a pretty complete anthropological description of the Ceboynas. The wife of the governor of the colony, Mrs. Blake, a most enthusiastic and able naturalist, whose contributions to science are well known, had herself explored one of the caves—an undertaking which calls for energy and endurance quite incomprehensible to any one who has never attempted exploration in the tropics. She had found fragments of several skeletons in the cave, and she placed them all in my hands as soon as I expressed a wish to study them. Dr. J. C. Alberry, a Nassau physician, was equally generous with a female skull in perfect preservation, which he had in his office, and both he and Mrs. Blake afterward authorized me to deposit these relics of a lost and almost unknown race in one of our great anthropological collections. The Nassau Public Library contains two male skulls which the trustees kindly permitted me to draw and measure.

As the result of my examination of this material, I am now able to state that the Lucayans were large people, about equal in size and stature to the average European, and very muscular and heavy. The bones, especially those of the skulls, are very thick, firm, and heavy, with a surface almost as dense and white as ivory. After examining the skulls, it is easy to credit the statement that the steel swords of the Spaniards were often broken over the hard heads of the Lucayans. The brain was large, and the capacity of the cranium is about equal to that of an average Caucasian skull; but they had protuberant jaws and the powerful neck- and jaw-muscles of true savages, and the outlines of the skulls have none of the softness and delicacy which characterize those of more civilized and gentle races of men. The eyes were very oblique, sloping downward away from the nose, and the orbits are very large and angular. The cheek-bones are broad and high, and the jaws peculiarly massive and square.

The skulls are extremely broad in proportion to their length, and they are among the most brachycephalic, or round-headed, of all known human skulls, the greatest breadth being more than nine tenths of the greatest length.

The Ceboynas flattened their heads artificially in infancy, so that the vertical part of the forehead is completely obliterated in all the adult skulls, and the head slopes backward immediately above the eyes. This flattening was practiced to such a degree that the bones of the child's skull were often broken by the pressure of the bandages, and two out of the four skulls had false joints, which appear to be the result of fracture produced in this way.

The type of the race is extremely well marked, and, after one of the skulls had been examined, it was easy to see at a glance that the others belong to the same people, and their characteristics agree closely with the very short description of the Ceboynas which Columbus gives.

In his log-book, October 13th, he says: "At dawn many of these men came down to the shore. All are, as already said, youths of good size and very handsome; their hair not woolly, but loose and coarse like horses' hair. They *have broader heads and foreheads than I have ever seen* in any race of men, and the eyes very beautiful, not small. None of them are black, but of the complexion of the inhabitants of the Canaries. All, without exception, have very straight limbs, and no bellies, and very well formed."

This passage, and a few others in his log-book, contain nearly all that is known of the race, for the rapidity with which discovery followed discovery was unparalleled; and the simple Lucayans attracted little interest or attention after the Spaniards found the large fertile islands of the Antilles and the civilization of Mexico.

We know, however, that the statements in the histories to the effect that they were naked, weaponless, and without arts, are incorrect, as they are based upon the impressions which Columbus formed during his first day among them.

It is true that the men who welcomed Columbus were naked and without weapons, and that, as they sat in their canoes, with their stiff, black hair cut straight across their low foreheads and hanging down behind in a long scalp-lock, with their naked bodies painted, "some black and some white and some red, and some whatever they find," they must have seemed like thorough savages. He soon found, however, that they had gardens and neat, well-swept houses, and that they knew how to manufacture cotton cloth, and had such simple clothing as suits the climate. Their large canoes, hewed out of the trunks of single trees, were large enough to hold forty or fifty men each, and "wonderfully built according to the locality," and Columbus says they were skillful boatmen, paddling with wonderful speed, and managing them with great dexterity.

Fragments of pottery, household utensils of carved wood, and rude pictorial carvings have been found in the islands, and the occasional discovery of beautifully polished stone implements proves, like the piece of gold marked with letters, that they were in communication with distant lands, for there is no rock, except soft coral limestone, anywhere in the archipelago. They knew the direction and distance of Cuba and Hayti, and they called the larger island by the name which it still bears. Their language was almost identical with that spoken in these islands, and, while they were upon the extreme edge of the civilization of the Gulf of Mexico, they were not entirely outside its influence, and the discoverers were able to use them as interpreters as far away from their home as Campeachy.

This is about the sum total of our knowledge of the Cebaynas, and does not their share in the discovery entitle them to our remembrance, and bind us to do what we can before November 12, 1892, to preserve them from complete oblivion?

What can we do to perpetuate their memory? There is one thing which would be a most worthy and becoming testimonial if it were practicable. The injury which they have sustained is past and irreparable, but if three years hence we could celebrate the institution of a wise, humane, and consistent method of dealing with the wards of our nation in place of the one which was initiated when Columbus devoted his first Sunday to a search for a fort, the shades of the Ceboynas might accept the sacrifice.

What else is there to be done? Can we not restore to the map the pretty word "Lucayas" as the name for the islands? Surely if Columbus has Columbia for his monument, the Lucayans are entitled to the Lucayas; and while this is only a little thing, it would be a graceful tribute to them.

In the little-known interior of the larger islands there are many caves which have never been disturbed. Canoes, stone implements, carved utensils, and other articles have been found from time to time in the out-islands, and, while the articles have no great archæological interest, the part played by their owners in the events which are so soon to be commemorated would give great value to any new discoveries.

The delightful climate and the beauty of the landlocked sounds give to the Bahamas the greatest charm as a cruising-ground; and if some yacht-owner were to devote himself to exploration, with a well-equipped and energetic staff of earnest assistants, he might hope to gather a collection of Ceboyna relics which, placed in one of our museums, would be a permanent monument to their memory.

Dr. Eduard Naumann, of Munich, has advanced the theory, in a British Association paper, that the magnetic curves of the earth, wherever a magnetic survey has been made, show a distinct relation to mountain ranges, faults, eruptions, and tectonic disturbances. He urges that the investigation of this subject be taken up at once all over the world.

SPEECH AND SONG.

BY SIR MORELL MACKENZIE.

PART I.—SPEECH.

IN dealing with the two great forms of local utterance, it will be most convenient to take them in their historical, or at any rate their logical, order. Whatever "native wood-notes wild" our hypothetical half-human ancestor may have "warbled" by way of love-ditties before he taught himself to speak, there is no doubt that singing as an *art* is a later development than articulate speech, without which, indeed, song would be like a body without a soul. I will, therefore, treat of speech first; and it will clear the ground if I begin with a definition. Physiologically, speech is the power of modifying vocal sound by breaking it up into distinct elements, and molding it, if I may say so, into different forms. *Speech*, in this sense, is the universal faculty of which the various *languages* by means of which men hold converse with each other are the particular manifestations. Speech is the abstract genus, language the concrete species.

I am happy to say it does not fall within the scope of my present purpose to discuss the origin of language, a mysterious problem, on which the human brain has exercised itself so much and to so little purpose, that some years ago, I believe, the French Academy declined to receive any further communications on the subject. The origin of the *voice* is a different matter. The vocal function is primarily a means of expression. I see no reason for disagreeing with Darwin, when he says that "the primeval use and means of development of the voice" was as an instrument of sexual attraction. The progenitors of man, both male and female, are supposed to have made every effort to charm each other by vocal melody, or what they considered to be such, and by constant practice with that object the vocal organs became developed. Darwin seems inclined to believe that, as women have sweeter voices than men, they were the first to acquire musical powers in order to attract the other sex, by which I suppose he means that the feminine voice owes its greater sweetness to more persevering culture for purposes of flirtation. I do not know whether the ladies of the present day will own this soft impeachment, or whether they will be flattered by the suggestion that their remote ancestresses lived in a perpetual leap-year of courtship. Other emotions, however, besides the master passion of love had to be expressed; joy, anger, fear, and pain had all to find utterance, and the nervous centers excited by these various stimuli threw the whole muscular system into violent contractions, which in the case of the muscles moving the chest and the vocal cords naturally produced sound—that is to say, voice. These movements, at first accidental and purposeless, in time became inseparably associated with the emotional state giving rise to them, so as to coincide with it, and thus serve as an index or expression thereof. From this to the voluntary emission of vocal sounds is an easy step, and it is probable enough that the character of those sounds was primarily due to the "imitation and modification of different natural sounds, the voices of other animals, and man's own instinctive cries." *

The mechanism of the voice is extremely simple in its general principles, though highly complex in its details. Fortunately, a knowledge of the latter is not required for the comprehension of the main facts relative to the production of the voice, and I shall not further allude to them here. Vocal sound is produced solely in the larynx, an elementary fact which must be thoroughly grasped, as many absurd notions are current even among people who should know better, such as that the voice may be produced at the back of the nose, in the stomach, and elsewhere. The larynx is a musical instrument of very complex structure, partaking both of the reed and the string type, the former, however, distinctly predominating. It is essentially a small chamber with cartilaginous walls, which is divided into an upper and a lower compartment by a sort of sliding floor, or double valve, formed by the two vocal cords. In breathing this valve opens, its two lateral halves gliding wide apart from each other, so as to allow a broad column of air to pass through; in speaking or singing, on the other hand, the valve is closed, but for a narrow rift along its middle. Through this small chink the air escaping from the lungs is forced out gradually in a thin stream, which is compressed, so to speak, between the edges of the cords, that form the opening technically called the "glottis," through which it passes. The arrangement is typical of the economical workmanship of Nature. The widest possible entrance is prepared for the air which is taken into the lungs, as the freest ventilation of their whole mucous surface is necessary. When the air has been fully utilized for that purpose, it is, if need be, put to a new use on its way out for the production of voice, and in that case it is carefully husbanded and allowed to escape in severely regulated measure, every particle of it being made to render its exact equivalent in force to work the vocal mill-wheel. When the air is driven from the lungs up the windpipe it strikes against the under surface of the floor or double valve formed by the vocal cords, which are firmly stretched to receive the shock, forces them apart to a greater or less extent, and, in rushing out between them, throws them into vibration.

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* "Descent of Man," second edition, 1882, p. 87.

The vibration of the vocal cords makes the column of air itself vibrate, and the vibration is communicated to the air in the upper part of the throat, the nose, and mouth, from which finally it issues as *sound*. The vocal cords are the "reeds" of the vocal instrument, and as, owing to the extraordinary number and intricate arrangement of their muscular fibers, they can change their length and shape and thickness in an almost infinite variety of ways, they are equal in effect to many different reeds. If the vocal cords can not move so as to bring their edges almost into contact, or if there is any substance between them which prevents them from coming together, the voice is destroyed; if there is anything (such as a growth) in or on one of them, its vibration is more or less checked, and hoarseness is the consequence. The primary sound generated in the larynx is modified by the shape, size, and density of the parts through which the vibrating column of air has to pass before it issues from the "barrier of the teeth." These "resonators," include the part of the larynx above the vocal cords, with the little sounding-board, the epiglottis, covering it; the upper part of the throat or pharynx, the nasal passages with certain echoing caves in the bones of the skull which communicate therewith; and the mouth, with the soft palate and uvula, tongue, cheeks, teeth, and lips. It is to these resonators, as well as to the size and shape of the larynx itself—and those parts, like the features of the face, are never exactly similar in any two individuals—that the distinctive quality, or *timbre*, of the voice is due.

Timbre is the physiognomy of the voice by which the speaker can be recognized even when unseen. Just as the face may be lit up with joy, darkened with sorrow, or distorted with passion, so may the voice be altered by strong mental emotion. This is due to the influence of the mind on the nervous system, which controls every part of the body: if it be stimulated, increased action will be excited; if disordered by shock, feeble irregular movements will be produced, the limbs will shake, and the voice tremble. From the effect of peculiarities of physical conformation on the voice it will be readily understood that *timbre* may be, in some degree, a national or racial peculiarity. There are also certain physical types which correspond to particular *timbres* of the voice. I have noticed this particularly in persons of like complexion even when different in race. Thus, a certain sharp metallic clearness of articulation is often found in individuals of ruddy complexion, light yellow hair, and hard blue eyes, while rich, mellow tones, with a tendency to *portamento* in ordinary speech, are often associated with black hair and florid face. A remarkable point is that the same voice may be altogether different in *timbre* in singing from what it is in speaking. The difference is probably due to the fact that in singing the resonators are, instinctively, or as the result of training, managed in a more artistically effective manner than in ordinary speech.

Speech differs from song as walking does from dancing; speech may be called the prose, song the poetry of vocal sound. Mr. Herbert Spencer has defined song as "emotional speech," but this term might with greater justice be used to designate the hystero-epileptic oratory which threatens to become acclimatized in this sober island, or even to the exchange of amenities between two angry cabmen. It would be more accurate to call song "musical speech," using the word "musical" in its strict sense as signifying sound with definite variations of tone and regularity of time. But, just as there may be "songs without words," so there may be speech without voice, as in whispering. Sound, as we have already seen, is produced in the larynx, but articulation, or the transformation of meaningless sound into speech, is performed in the mouth; in speaking, therefore, the two parts work together, the larynx sending out a stream of sound, and the mouth, by means of the tongue, cheeks, palate, teeth, and lips, breaking it up into variously formed jets of words. In other words, the larynx supplies the raw material of sound which the mouth manufactures into speech. Time, which is an essential element of song, is altogether disregarded in speech, while the intervals of tone are so irregular as to defy notation, and are filled up with a number of intermediate sounds instead of being sharply defined. The voice glides about at its own sweet will in speaking, obeying no rule whatever, while in song it springs or drops from one tone to the next over strictly measured gaps. In singing, short syllables are lengthened out and cease in fact to be short, and (except in certain kinds of dramatic singing and in recitative) the accent naturally falls on the vowels and not on the consonants. In speaking, only the lower third of the voice is employed as a rule, while in singing the greatest effect is generally produced, except in the case of contraltos and basses, by the use of the upper and middle notes. In speech the range of tone, even in the most excitable persons, hardly ever exceeds half an octave; in singing the average compass is two octaves. Singing tends to preserve purity of language, the rules which govern the utterance of every note also affecting the articulate element combined with it, and keeping the words cast in fixed forms—a stereotype of sound, if I may venture the metaphor. Speech, on the other hand, like handwriting, is always changing. As Max Müller says: "A struggle for life is constantly going on among the words and grammatical forms in each language. The better, the shorter, the easier forms are constantly gaining the upper hand, and they owe their success to their own inherent virtue."* Thus speech not only tends to split language into dislects, but each dialect is being continually, though imperceptibly, modified not only in construction but in pronunciation. The pronunciation of an Englishman of Chaucer's day would be unintelligible to us, while that of one of Shakespeare's contemporaries would be as strange to our ears as the accent of an Aberdeen fishwife is to the average cockney. If the speaking voice has a distinctly sing-song character—that is to say, if it proceeds by musical intervals—the result is as grotesque as it would be to talk in blank verse, or, as Sir Toby Belch says, "to go to church in a galliard and come home in a coranto." On the other hand, the speaking voice becomes most sympathetic in its quality when it approaches the singing voice, the musical character, however, being concealed by the variety of its inflections. It is important that in speaking a musical note should never be recognized; the effect is as unpleasant to our ears as an accidental hexameter in a sentence of prose was to the ancients.

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* "Nature," January 6, 1870.

Wide as the difference is between speech and song, the great gulf fixed between them is partly filled up by intermediate modes of using the voice which partake of the nature of both. Thus there is the measured utterance of declamation, which may be so rhythmical in time and varied in tone as to be almost song. On the other hand, the *recitativo* of the opera approaches speech. Various intermediate forms between speech and song may be heard in the ordinary speech of certain races, notably in Italians, Welshmen, and the inhabitants of certain parts of Scotland and England. The Puritans, as is well known, uttered their formal and affected diction in a peculiar nasal tone; and the term "cant," though properly belonging to their sing-song delivery, came to be applied to the sentiments expressed by it. Many of the ancient orators, to judge from the description left us by Cicero and Quintilian, would seem to have *sung* their speeches, the style of declamation being, in fact, expressly termed *cantus obscurior*. As they generally spoke in the open air, and to vast audiences, this artificial mode of delivery may have been necessary in order to make the voice reach farther than if they had spoken in a more natural way. C. Gracchus used to have a musician behind him while he spoke, to give him the *note* from time to time with a musical instrument called a *tonarion*. A similar plan might, with much advantage to the "general ear," be adopted by certain modern orators, the *crescendo* of whose enthusiasm expresses itself in increasing intensity of shrillness.

Those who have not given much attention to the subject are apt to think of speaking, as Dogberry did of reading and writing, that it "comes by nature"—that it is, in fact, an instinctive act, which no more needs cultivation for its right performance than eating or sleeping. This is a great mistake. Speaking, even of that slipshod kind which is mostly used in ordinary conversation, is an *art*, and as such has to be *learned*, often with much labor. The complicated muscular actions, the nice nervous adjustments, the combination of these into one harmonious effort directed to a particular end, and, finally, the mastery of all these movements till they can be produced automatically without a direct and continuous exercise of will-power, form a complex process which takes years to learn, and which by many is even then very imperfectly acquired. Good speaking is a higher development of the art, which bears the same relation to speech as ordinarily heard that the horsemanship of an Archer or a Cannon bears to the performance of a costermonger's boy on the paternal donkey.

A man who speaks well not only makes himself intelligible to his hearers without difficulty to them, but with a minimum of effort on his own part. If the voice is properly used, the throat hardly ever suffers, but wrong production is a fertile source of discomfort and even disease in that region. It should be clearly understood that public speaking, in addition to its intellectual aspects, is a physical performance which requires "wind" and "muscle" and the perfect management of one's bodily resources, like any other athletic feat. To attempt to speak in public without previous training is like trying to climb the Matterhorn without preparation, and is just as certain to end in failure if not disaster.

It is hardly an exaggeration to say that the training of the voice should begin almost in the cradle. I do not, of course, mean that a baby should be taught to squall according to rule, or that the prattle of children should be made a laborious task. But I wish to insist on the importance of surrounding the child, as soon as it begins to lisp, with persons who speak well. "All languages," as old Roger Ascham says, "both learned and mother tongues, are begotten and gotten solely by imitation. For as ye use to hear so ye learn to speak; if you hear no other ye speak not yourself; and whom ye only hear of them ye only learn." Quintilian says: "Before all . . . let the nurses speak properly. The boy will hear them first, and will try to shape his words by imitating them." This applies chiefly to pronunciation and the correct use of words; but much might also be done for the right management of the voice if every child could grow up among people who speak well. I should be disposed to make it an essential point in the selection of a nurse or governess that she should have a good voice as well as a refined accent.

In antiquity the training of an orator was almost as elaborate an affair as the training of a race-horse is with us. Not only the voice, but the whole man, physical, intellectual, and moral, was carefully prepared, with conscientious minuteness of detail, for the great business of life, the making of speeches. In this system of education the development of the voice naturally held a large place, and the *phonascus*, or voice-driller, was an indispensable accessory, not only of every school of oratory, but of many formed orators. Of the methods of the *phonascus* we know little, but we find hints in some of the classical writers that, like certain of his professional brethren in more recent days, he was not disinclined to magnify his office. Seneca, in one of his letters, warns his friend against living, vocally speaking, in subjection to his *phonascus*, and implies that he might as well keep another artist to superintend his walking. In our own day the *phonascus* still survives in public life, though perhaps more as a luxury than an acknowledged necessity. A celebrated novelist, dramatic author, and orator, who passed over to the great majority many years ago, used always to put himself under the guidance of a vocal mentor before delivering a speech. Every tone, every pose, and every gesture was carefully prepared and industriously practiced, under the direction of Mr. Frederick Webster, brother of the celebrated comedian, Benjamin Webster. That the elaborate training of the ancients was eminently successful is shown by the powers of endurance which it is clear they must have possessed. They habitually spoke for five or six hours, and even longer, and, in order to appreciate their staying power, it must be remembered that they spoke in the open air, amid all the tumult of the forum, which was capable of holding eighty thousand people, and with an amount and vigor of action of which the gesticulations of an Italian preacher are but a pale reflex. Long-windedness was at one time cultivated as a fine art by Roman orators, when they had to plead before a judge whom they supposed to be in favor of the other side. These prototypes of our modern obstructionists were aptly termed *moratores*, or delayers, because they postponed as far as possible the passing of the sentence. The abuse finally reached such a height that a law had to be passed limiting the length of pleadings in public cases to the running out of one clepsydra. It is impossible to say exactly what period of time this was equivalent to, as the water-clocks of the Romans were of different sizes, and the rapidity of flow must have varied under different circumstances; from twenty minutes to half an hour may, however, be taken as roughly representing the average length of a speech under this strict system of "closure." On the whole, I think we use the voice in public even more than the ancients, and there is, therefore, all the more reason for its being properly trained. Good speaking is nowadays important, not only from the artistic but from the business point of view; and, even for "practical men," it can not be a waste of time to acquire so valuable a faculty. These arguments may perhaps seem superfluous, as the proposition they are intended to support is self-evident. I lay stress on them, however, because I am convinced that the necessity of training the speaking voice is very imperfectly appreciated by most people.

It is not within my province to discuss the technical details of voice-training. I will only say that every system of vocal instruction should aim at strengthening the power of the voice, increasing its compass, and purifying its tone, and, above all, at giving the speaker perfect control over it, even in the very whirlwind of oratorical passion. It would be well if every school in the land had a master of elocution attached to it, and if the art of delivery were taught to every boy as part of the regular course of education. In the excellent system of education which Rabelais sketched out, the development of the voice is expressly mentioned as part of Gargantua's athletic training. In the middle of a detailed description of his swimming and climbing exercises and practice in the use of weapons of all kinds, we are told that "pour s'exercer le thorax et poulmons crioit comme tous les diables. Je l'ouy une fois appellant Eudemon depuis la porte Sainct Victor jusques à Montmartre. Stentor n'eut onques telle voix à la bataille de Troye."* There is a hint for schoolmasters of the present day. The "young barbarians" under their charge might by degrees be made to look on strength and beauty of voice, and skill in using it, as an *athletic* distinction; this would at once ennoble the subject in their eyes, and make elocution a matter of keen competition.

As part of the general vocal training which I think desirable, I should be disposed to urge that *all* children and young people should learn to sing as far as their natural capacity will allow. Even those with little or no musical endowment will thus learn to use their voices better in speaking. I may say here, though it is rather anticipating, that, if I think it desirable for speakers to learn to sing, I think it still more necessary that singers should learn to speak. Too many of those who soar aloft on the wings of song despise the *musa pedestris* of speech, and take no trouble to acquire what they look upon as an inferior and possibly superfluous accomplishment—with what result is known to cultivated listeners whose ears have been tortured by the uncouth distortions and mutilations to which singers often subject the words they have to utter.

Of the management of the voice I can not say much here. The chief thing is that the speaker should make himself distinctly heard by the whole of the audience, and to this end art serves better than loudness. A weak voice, properly managed, will carry farther than a powerful organ worked by sheer brute force. Mr. Bright's use of his voice always gave one the impression of a large reserve of power. There seemed to be no effort in his delivery, even when speaking to a mighty concourse of people, and yet his voice was

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* For exercise, his throat and lungs cried out like all the devils. I once heard him calling Eudemon from the *Porte* Saint Victor to Montmartre. Stentor in the Trojan War had no such voice.

> "To the last verge of the vast audience sent,
> And played with each wild passion as it went."

One element of success in this matter is no doubt the art of compelling an audience to listen. As Montaigne, in his quaint old French, says: "La parole est moitié à celuy qui parle, moitié à celuy qui l'escoute; celuy cy se doibt préparer à la recevoir, selon le bransle qu'elle prend: comme entre ceulx qui jouent à la paulme, celuy qui soubstient se desmarche et s'appreste, selon qu'il veoid remuer celuy qui luy jecte le coup et selon la forme du coup."* Every speaker should know the exact limits of his own vocal powers, and he must be careful never to go beyond them, for the sake of his hearers no less than his own. He must learn to judge instinctively of distance, so as to throw his voice to the farthest part of his audience. A speaker, and, I may say, a singer also, should not hear his own voice too loudly. Artistes and orators are often very much disappointed, and think their voice is not traveling well when they themselves do not hear it very distinctly. The fact is that when the speaker does not hear his voice this proves that it reaches to a distant part of the room, and that there is very little rebound. Here I may remark that we never hear our voices as other people hear them. Our own voices are conveyed to the auditory nerve, not only through the outside air, but more directly from the inside, through the Eustachian tube, as well as through the muscles and bones of the mouth and head; the singer not only hears his own voice from a different quarter, as we may say, but he hears besides the contraction of his own muscles. The fact is well illustrated by the phonograph: a listener can recognize other people's voices, but if he speaks into the phonograph, and afterward reproduces his own voice, it does not sound at all like itself to him, because he does not hear it in the manner he is accustomed to, and because he hears it stripped of the various accompanying sounds which are usually associated with it to his ear.

The acoustic peculiarities of the place in which he has to speak must, if possible, be carefully studied beforehand by the orator. Public buildings, however, vary so greatly in their size and construction that it is impossible to lay down any general rules for the guidance of speakers in this matter. Each hall, church, court, and theatre has its own acoustic character, which can be learned only by experience; the voice must be, as it were, *tuned* to it. It is well if this experience can be gained by the orator before he faces his audience; but he must remember that trying his voice in an empty room is an altogether different thing from actually using it in the same place packed with a solid mass of wheezing, coughing, and perspiring humanity. Handel is said to have comforted himself, when one of his oratorios had been performed to empty benches, by the reflection that "it made ze moosic shound all ze better," but this consolation is denied to the orator. There are some buildings which are so utterly bad from the acoustic point of view that even experienced speakers are little better off than novices. The House of Lords has, or used to have, an unenviable reputation in this respect. A story is told of the late Lord Lyttelton that, after exhausting his voice in vain efforts to make his brother peers hear a motion which he wished to propose, he in despair wrote it down and asked the clerk at the table to read it out. That functionary, however, was quite unable to decipher the writing, and Lord Lyttelton complained that he was cut off from communication with his fellows. Science has not always been successful in coping with the acoustic difficulty. In 1848 it was so difficult for speakers to make themselves heard in the French Chamber, that a committee, consisting of the leading scientific luminaries of the day—such as Arago, Babinet, Dumas (the chemist, not the author of "The Three Musketeers"), Becquerel, Chevreul (the centenarian who died the other day), Pouillet, Regnault, and Duhamel—was appointed to study the case and suggest a remedy. After numerous experiments they hit on a contrivance, designed on the most scientific principles, which was to make the orator's voice ring like a clarion to the farthest benches. The last state of the speaker, however, was worse than the first; he felt as if his voice was stifled under a huge night-cap, and the highly scientific sound-reflector had to be discarded as a failure. Indeed, modern public buildings are so often defective in this respect that I am not surprised to find M. Ch. Garnier, who designed the Grand Opéra in Paris, exclaiming dolefully, "The science of theatrical acoustics is still in its infancy, and the result in any given case is uncertain." So impressed is he with the shortcomings of modern architecture as regards the conveyance of sound, that he frankly confesses that, in the construction of the Opera-House, he "had no guide, adopted no principle, based his design on no theory"; he simply left the acoustic properties of the building to *chance*. The result has not been altogether satisfactory, though it has been no worse than in many other buildings where the architect did his best to make the acoustic conditions perfect. One of the most remarkable buildings from the acoustic point of view that I have ever seen is the beehive-shaped Temple in Salt Lake City. It holds from twelve to fourteen thousand people, and one can literally hear a pin fall. When I was in the Temple, with some other travelers, in 1882, the functionary corresponding to the verger of ordinary churches stood at the farthest end and dropped a pin into his hat. The sound of its fall was most distinctly audible to all present. The scratching of the pin against the side of the hat was also plainly heard across the whole breadth of the building. The Temple was designed by Brigham Young, who professed to have been directly inspired by the Almighty in the matter, as he knew nothing of acoustics. The resonance of the building is so loud that branches of trees have to be suspended from the ceiling in several places in order to diminish it. It is likely enough that Brigham Young's inspiration had a not very recondite and purely terrestrial source, for his Beehive is only a slight modification of the whispering-gallery in St. Paul's. The bad acoustic properties of buildings may be remedied by what doctors call "palliative treatment." Charles Dickens's experience as a public reader made him a man of ready resource in meeting such difficulties. On one occasion, when he was going to lecture at Leeds, Mr. Edmund Yates, who had spoken in the same hall the evening before, sent him word that the acoustic conditions of the place were very bad. Dickens at once telegraphed instructions that curtains should be hung round the walls at the back of the gallery; by this means he was able to make himself more easily heard.

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* Speech belongs half to the speaker and half to the hearer; the latter should prepare himself to receive it, according to the impetus it obtains. As with tennis-players, the one to whom the ball is served poses and makes ready according to the motions of the server and the form of the service.

The speaker should take the greatest care of his voice, which is the instrument both of his usefulness and of his fame, but of course it is not always easy for him to do so. Still, he should, if possible, make it a rule not to speak when his voice is hoarse or fatigued, and, when he has a great oratorical effort to make, he should reserve himself for it. Tobacco, alcohol, and fiery condiments of all kinds are best avoided by those who have to speak much, or at least they should be used in strict moderation. I feel bound to warn speakers addicted to the "herb nicotian" against cigarettes. Like tippling, the effect of cigarette-smoking is cumulative, and the slight but constant absorption of tobacco juice and smoke makes the practice far more noxious in the long run than any other form of smoking. Our forefathers, who used regularly to end their evenings under the table, seemed to have suffered little of the well-known effects of alcohol on the nerves, while the modern tippler, who is never intoxicated, is a being whose whole nervous system may be said to be in a state of chronic inflammation. In like manner cigarette-smokers (those at least who inhale the smoke, and do not merely puff it "from the lips outward," as Carlyle would say) are often in a state of chronic narcotic poisoning. The old jest about the slowness of the poison may seem applicable here, but, though the process may be slow, there can be little doubt that it is sure. Even if it does not kill the body, it too often kills or greatly impairs the victim's working efficiency and usefulness in life. The local effects of cigarettes in the mouth must also be taken into account by those whose work lies in the direction of public speech. The white spots on the tongue and inside of the cheeks, known as "smoker's patches," are believed by some doctors with special experience to be more common in devotees of the cigarette than in other smokers; this unhealthy condition of the mouth may not only make speaking troublesome, or even painful, but it is now proved to be a predisposing cause of cancer. All fiery or pungent foods, condiments, or drinks tend to cause congestion of the throat, and if this condition becomes chronic it may lead to impairment, if not complete loss, of voice. The supposed miraculous virtues of the mysterious possets and draughts on which some orators pin their faith exist mainly in the imagination of those who use them; at best they do nothing more than lubricate the joints of the vocal machine so as to make it work more smoothly. This is just as well done by means of a glass of plain water. In France water sweetened with sugar is the grand vocal elixir of political orators. As Madame de Girardin said, somewhat unkindly: "Many things can be dispensed with in the Tribune. Talent, wit, conviction, ideas, even memory, can be dispensed with, but not *eau sucrée*." Stimulants may give a sort of "Dutch courage" to the orator, and may carry him successfully through a vocal effort in which indisposition or nervousness might otherwise have caused him to fail, but the immediate good which they do is dearly purchased by the thickening and roughening of the mucous surface of the throat to which they ultimately give rise.

Before leaving the subject of the speaking voice, a word or two may be said on what is more a matter of curious speculation than of practical interest. Is the human voice growing in power and beauty, or is it tending to decay? Certain physiologists assure us that the retina has acquired the power of distinguishing colors by degrees, and that the process will probably continue, so that our descendants will by and by evolve the power of seeing colors now quite unknown to us. On the other hand, it is undeniable that civilization, so far from increasing the keenness of our sight, threatens to make spectacles universally necessary. There can be no doubt that the voice has developed greatly since our "half-human ancestors" wooed each other in the primeval forests, and it is conceivable that it may in time to come acquire the power of producing musical effects at present undreamed of. It is also probable enough that as the voice gains in sweetness it may lose in power, the latter quality being more required in barbarous than in highly civilized conditions. On the other hand, we are taller and of larger chest-girth than our predecessors even of a not very remote date; it is reasonable, therefore, to suppose that the average lungs and larynx are bigger nowadays, and the air-blast from the lungs stronger. This would appear to justify us in believing that the voice is stronger than it was even two or three centuries ago. There are, however, no facts that I know of to prove it.

Of the *ethnology* of the voice little or nothing is certainly known. Almost the only facts I know of coming under this head are—(1) the superior sonorousness of the Italian voice, and (2) the want of resonance in the voices of some Australian aborigines, which is supposed to be due to the extreme smallness of the hollow spaces in the skull which serve as resonance chambers. Yet there is an infinite diversity in the voices of different nations, arising from difference of physical conformation, habit of speech, climate, etc. It is to our climate that Milton attributed the fact, which strikes all foreigners, that English people speak with the mouth half shut. "For we Englishmen," he says, "being far northerly, do not open our mouths in the cold air wide enough to grace a southern tongue, but are observed by all other nations to speak exceeding close and inward; so that to smatter Latin with an English mouth is as ill a hearing as law French." Then look at our American cousins, in whom it is not the mouth but the nose that is the "peccant part"—is it climate or variation of structure that has wrought the change in their original English speech; or is it simply a twang inherited from their Puritan ancestors, who took their "cant" with them to the New World? Americans, including even so refined a scholar as Mr. Lowell, boast that they alone keep the true tradition of English speech; but I can not believe that our forefathers, "in the spacious times of great Elizabeth," spoke in the accents of Hosea Biglow. The difficulty, or rather impossibility, of studying the variations of the voice under culture has been due to the want of any means of permanently recording its tones. Now, however, that the phonograph has emerged from the condition of a scientific toy, comparative *phonology* may, perhaps, take its place among the sciences. Besides this and other results, Mr. Edison's wonderful instrument will preserve the fame of orators, actors, and singers—hitherto the most evanescent kind of glory, as it had to be taken altogether on trust—in a form as concrete as a picture or a poem. The little revolving cylinders will reproduce "the sound of a voice that is still," and will enable us to have "the little voice set lisping once again" years after our darling has been laid in an untimely grave. There seems to be something almost uncanny in the power of thus permanently enshrining the most fleeting part of man, and reawakening at will the living accents of one who, being dead, yet speaketh to the bodily ear.—*Contemporary Review.*

SKETCH OF PROF. JOHN LE CONTE.

BY PROF. W. LE CONTE STEVENS.

THE subject of the present sketch is the Professor of Physics in the University of California, where he has for many years been associated with his brother, the distinguished geologist and writer on evolution. He was the second son of Louis Le Conte, and was born on the 4th of December, 1818, at the family homestead in Liberty County, Georgia. The father was a man of much independence of character, firm and decided, yet kind and gentle, exceedingly fond of investigation, original in thought, but singularly indifferent to popular recognition. He published nothing himself, and would never have become known away from his own home, had not others been appreciative enough of his real merit to give some of his results to the world by presenting them before the New York Lyceum of Natural History.

By personal influence and example, Louis Le Conte inculcated in his sons the love of science, and of truth for its own sake. The virtue of verification was one which he sought to cultivate in them as of cardinal importance. An illustration of the success of his teaching in this direction, and of the early growth of the philosophical habit of mind in his son John, was afforded on one occasion when the father and a number of neighbors, while patrolling at night to check some illicit transactions between the negro slaves and the shopkeepers of the nearest village, were fired upon with blank cartridges, and thrown from their startled horses. Relating the story of his mishap after he had reached home, the father said, "I lost my left stirrup; at the turn in the road I lost the other stirrup, and at the next turn I was thrown." John, who listened to the narrative with great interest, was perplexed to know how the stirrups could have been lost. His night's rest did not remove the trouble, and, leaving his bed before sunrise, he went and examined the saddle. He reported upon the result of his investigation at the breakfast-table. "Pa, did you not say last night that, when the horse ran away with you, you lost your stirrups?" "Yes, my son, I did say so." "Well, I have found that the stirrups are safe and sound." The laugh was turned against the son, and the father often told the story afterward as a joke upon him. It was, however, no joke; it was a prediction of the career of the future investigator in physics.

The childhood and most of the boyhood of John Le Conte were spent at the plantation home in Georgia, where hunting, fishing, boating, and all kinds of athletic sports contributed largely to the training of his observing faculties. His uncle, Major Le Conte, an accomplished zoölogist, often gave up his New York home in winter for the purpose of spending the colder months on the Southern plantation. The scientific proclivities of both father and uncle insensibly made all the children students of natural history and collectors of specimens. Thus they gradually imbibed knowledge on such subjects, and acquired powers of discrimination that are ordinarily attained only by years of study in maturer life. Their mother died in 1826, leaving the father in charge of six children. Deprived of maternal care at so early a period of life, all of them, and especially the boys, were thrown largely upon their own resources at a tender age.

In those days and in that country neighborhood, forty miles from the nearest city, Savannah, it was necessary to do without the school accommodations that are now abundant in every village of our land. An isolated wooden-framed house, with no plastering, a single door for its single room, abundant ventilation through the crevices of the floor and walls, fully supplemented by the draught through an ample clay chimney—such was the school-house in which the children were gathered daily from plantations varying in distance from one to half a dozen miles or more. The teacher was rarely ever of the best. One there was who took charge of this road-side seminary for two years, became the intimate friend of Mr. Le Conte, and exerted over his boys an influence that became life-long. Alexander H. Stephens, the future statesman and historian, was then a young graduate who sought in teaching the pecuniary support that was necessary while he was preparing for admission to the bar. His fine classical taste and clear, logical mind produced a lasting impression upon John Le Conte, who received thus his training for college, and entered Franklin College, now the University at Athens, Ga., with distinguished success in January, 1835.

As a student, young Le Conte soon became noted for his clearness of conception and his scrupulous accuracy in work. The curriculum of study was the same for all, irrespective of native bias or prospective aim in life. He was fully appreciative of all the classical culture that was there afforded, but his tastes naturally led him into spending on mathematics and its applications a larger share of attention than Latin and Greek could attract. "Give him the cosine of A and he will prove anything," was the criticism expressed by an admiring fellow-student, and concurred in by the rest. The formal teaching of physics and chemistry involved mere text-book recitation, and attendance upon illustrated lectures of the most elementary character, which were delivered with oracular authority. It was more than whispered among the students that on these topics John Le Conte knew as much as or more than the professor himself.

During his senior year at college Mr. Le Conte was bereft of his devoted father, who died after a very brief illness. This calamity hastened his selection of a profession. In August, 1838, he was graduated with high honor. Immediately afterward he began the study of medicine; and in the spring of 1839 he entered the College of Physicians and Surgeons in New York, where, in March, 1841, he received the degree of Doctor of Medicine. A few months before his graduation in medicine another domestic calamity befell him in the death of his eldest brother, William, to whom had been committed the charge of the family estates in Georgia. This event hastened Dr. Le Conte's return home in the spring of 1841, to take charge of the estate as the eldest surviving son, and frustrated the execution of a cherished plan for supplementing his medical education by a year's residence in Paris.

During the summer of 1841 Dr. Le Conte returned to New York, and was married in July to Miss Josephine Graham, of that city, an accomplished young lady of Scottish and English extraction. The deep love and earnest devotion, and the consequent domestic happiness which crowned this union, contributed more than all else afterward to fortify and sustain him in the battle of life. Mrs. Le Conte was a woman of wonderful personal magnetism, queenly in bearing, and of extraordinary beauty. Her brilliancy and wit, her quick insight and ready tact, added to her majestic presence, made her the center of attraction in every social gathering. In after-years, especially at the annual meetings of the American Association for the Advancement of Science, such men as Bache, Peirce, Henry, and Agassiz vied with each other in doing her homage. Her fame in social circles equaled that of her husband among men of science; and no important step in his life has been taken without acknowledgment of the help derived from the social influence of a wife of whom he was justly proud.

In the autumn of 1842 Dr. Le Conte established himself as a practitioner of medicine in Savannah, Georgia. His four years of residence in that city formed no exception to the usual experience of a young doctor: a very small practice and an increasing family. It afforded, however, an excellent opportunity for study and research, and it was during this period that he made his most important contributions to medical literature. These at once established his reputation in the profession as an acute observer, cautious, exact, and industrious. The first of them, entitled "A Case of Carcinoma of the Stomach," published in the "New York Medical Gazette" in 1842, was the initial outcome of a series of observations on cancer that has been continued from time to time, even after Dr. Le Conte's abandonment of the practice of medicine. At this period he probably paid more attention to physiology than to any other of the departments included in medical science, and his fondness for research interfered to some extent with the efforts that might have been made to secure paying patients.

In August, 1846, Dr. Le Conte accepted the chair of Natural Philosophy and Chemistry in Franklin College, his *alma mater*, from which he had gone forth eight years before as the best scientific student in his class. This decided his withdrawal from the field of practical work in medicine. Henceforth he devoted himself to the study of physical science, but without failing to keep pace still with the progress of physiology. He retained his professorship at Athens for nine years, resigning it in the autumn of 1855 to become lecturer on chemistry in the College of Physicians and Surgeons, his medical *alma mater*. In the spring of 1856, at the conclusion of his course of lectures in New York, he accepted a call to the South Carolina College at Columbia, where he had been unanimously elected to fill the chair, then first created, of Natural and Mechanical Philosophy. This position he held until the college was disbanded soon after the opening of the civil war. He was then put in charge of the Niter and Mining Bureau of South Carolina. In 1866 the University of South Carolina was organized, and Dr. Le Conte was elected to the same chair that he had held in the college of which this was the new development. This position he retained until 1869, when he gave up his residence in Columbia to become an adopted citizen of California. Here his home has continued up to the present time.

The period of thirteen years embracing Dr. Le Conte's connection with the South Carolina College and University, although clouded by the saddening events incident to the civil war, constituted the pleasantest and most satisfactory period of his life. The institution was governed by a board of trustees composed of gentlemen of refinement and culture, who entertained a genuine sympathy for the labors of the student who strives to plant himself at the most advanced outposts of science and literature. The community amid which the college had been developed was strongly influenced by the atmosphere of scholarship which it produced. There was a quiet spirit of encouragement to learning, which, by its freedom from pretension, furnished the most grateful incentive to study. It was during these years that Dr. Le Conte established a European reputation through his writings, which were published chiefly in the "American Journal of Science" and the "London Philosophical Magazine." It was in 1857 that he made the remarkable discovery of the sensitiveness of flame to musical vibrations—a discovery which served as the starting-point for Barrett, Tyndall, and Koenig in the exquisite applications that have since been worked out by the use of flame for the detection of sounds too delicate for the ear to perceive, and for the optical analysis of compound tones. Unfortunately, Dr. Le Conte did not possess the wealth of instrumental appliances needed for the development of his unique discovery, but his priority was gracefully proclaimed by Tyndall in the now classic book on sound, made up of lectures delivered at the Royal Institution. Among other papers that attracted marked attention in Europe was one "On the Adequacy of Laplace's Explanation to account for the Discrepancy between the Computed and the Observed Velocity of Sound in Air and Gases," written in 1861 and published in 1864. Laplace's modification of Newton's formula had been questioned by eminent English mathematicians and physicists. Dr. Le Conte showed that the obscurity into which the subject had been thrown was due to misconception of the physical theory of Laplace, and to the difficulties and obscurities which invest the mathematical theory of partial differential equations in their application to physical questions. This paper evoked replies from Profs. Challis, Earnshaw, and Potter, in England; but the American physicist's position is generally accepted to-day. The paper is a model of exact physical reasoning. In addition to the discussion of Laplace's views, it contains an original investigation of the bearing of the phenomena attending the propagation of sound in air on the question whether the gases constituting our atmosphere are in a state of mixture or of combination.

Just before the close of the war the home of Dr. Le Conte was included in the belt of desolation that was left by General Sherman's march through South Carolina. Among the losses by fire was the manuscript of a volume on general physics, the product of Dr. Le Conte's many years of experience as a teacher and student of this subject. The tribulations of the reconstruction period in South Carolina during the years following the war made scientific investigation impossible. The political turmoil, and the inauguration of the rule of ignorance and vice in place of intelligence, left no refuge but expatriation for those whose occupations depended upon the embellishments of civilization. To this source of disquietude was added the burden of domestic affliction in the loss of an only daughter in the bloom of early womanhood.

At this critical time came a call to the Pacific coast, to assume the chair of Physics and Industrial Mechanics in the University of California, which was then in the incipiency of its organization. The offer was accepted, and Dr. Le Conte arrived in San Francisco in April, 1869. Being immediately appointed acting president, he drew up the first prospectus of the university, in which was set forth a synopsis of the proposed courses of instruction. In September of the same year exercises were begun in temporary buildings at Oakland, where during the following summer he conferred the baccalaureate degree on three young men, and then retired from executive duties in order to build up more thoroughly his own department of work. On the resignation of President Gilman in 1875, Dr. Le Conte was induced again to assume the presidency, which he retained until June, 1881, but still performing the duties of his professorship. Since that date he has confined himself to his chair of Physics.

Through nearly the whole of life the two brothers, John and Joseph Le Conte, have been closely associated, each attaining eminence, the elder as a physicist, the younger as a geologist. The elder preceded the younger by six years at Franklin College, in Georgia. They went almost together to the South Carolina College, and likewise to the University of California. This fact has often led to their names becoming confounded by strangers.

Dr. Le Conte is a member of the National Academy of Sciences, the American Association for the Advancement of Science, the American Philosophical Society and Academy of Natural Sciences in Philadelphia, the New York Academy of Sciences, and the California Academy of Sciences. To this list might be added various other bodies which have bestowed upon him honorary membership.

A list of some of the more important of Dr. Le Conte's published writings is appended. The entire list is too long for insertion, amounting to about a hundred papers.

Of the first dozen, which show the direction of his tastes as a physician, perhaps the most interesting is No. 9, in which by original experiments he proved that the alligator is able to execute deliberate and determinate movements after decapitation and even after destruction of the spinal cord.

In No. 10 he shows that the mortality from cancer has increased in modern times; that it augments regularly with increasing age, and that it is greater in France than in England. The same subject is pursued still further in No. 28 and No. 49, in which he shows important errors in the usual methods of interpreting vital statistics, and that the average mortality from cancer is fully three times as great among females as among males.

In No. 16 he gives the first rational explanation of a whole class of ice phenomena as manifested both in the ground and in plants. In No. 17 the investigation is continued, and from numerous experiments it is shown that many plants may be completely frozen without injury.

No. 19 is a criticism of Moseley's theory of the descent of glaciers, in which it is demonstrated that the descent can not be produced by expansions and contractions of the ice due to changes of temperature.

In No. 20 it is shown that Maury's theory of the winds is untenable. This conclusion is now universally accepted, great as was the value of Maury's work in the pioneer days of meteorology.

In No. 23 it is shown that solar light has no sensible influence on combustion. This paper, as well as Nos. 16 and 17, was extensively reproduced in Europe. The same remark applies to Nos. 24 and 26, which have been already discussed.

In Nos. 25 and 39 an account is given of investigations regarding the depth, transparency, and color-tints displayed in some remarkable bodies of water.

No. 35 contains the description and discussion of some unique experiments on the propagation of vibrations through water, the source of disturbance being explosions of great violence. The results were wholly new, and attracted much attention in Europe.

In Nos. 37 and 41 the principles of capillarity are very thoroughly discussed, and illustrated by some new experiments.

Many others of these papers might be summarized, but only by exceeding the limits of a brief biographical sketch.

SCIENTIFIC.

1. "Case of Carcinoma of the Stomach" ("New York Medical Gazette," 1842).

2. "On the Mechanism of Vomiting" ("New York Lancet," 1842).

3. "On Carcinoma in General, and Cancer of the Stomach" (ibid., 1842).

4. "On the Explanation of the Difference in Size of the Male and Female Urinary Bladder" (ibid., 1842).

5. "An Essay on the Origin of Syphilis" ("New York Journal of Medical and Collateral Sciences," 1844).

6. "Remarks on Cases of Inflamed Knee-Joint" (ibid., 1844).

7. "Extraordinary Effects of a Stroke of Lightning.—Singular Phenomena" (ibid., 1844).

8. Observations on Geophagy" (Southern Medical and Surgical Journal," 1845).

9. "Experiments illustrating the Seat of Volition in the Alligator, or Crocodilus Lucius of Cuvier. With Strictures on the Reflex Theory" ("New York Journal of Medical and Collateral Sciences," 1845 and 1846).

10. "Statistical Researches on Cancer" ("Southern Medical and Surgical Journal," 1846).

11. "On the Quarantine Regulations at Savannah, Ga." ("New York Journal of Medical and Collateral Sciences," 1846).

12. "Remarks on the Physiology of the Voice" ("Southern Medical and Surgical Journal," 1846.

13. "Dr. Bennet Dowler's Contributions to the Natural History of the Alligator" (ibid., 1847).

14. "On Sulphuric Ether" (ibid., 1847).

15. "The Philosophy of Medicine: An Address" (ibid., 1849).

16. "Observations on a Remarkable Exudation of Ice from the Stems of Vegetables, and on a Singular Protrusion of Icy Columns from Certain Kinds of Earth during Frosty Weather" ("Proceedings of the American Association for the Advancement of Science," 1850; also, "Philosophical Magazine," 1850).

17. "Observations on the Freezing of Vegetables, and on the Causes which enable some Plants to endure the Action of Extreme Cold" ("American Journal of Science," 1852; also "Proceedings of the American Association for the Advancement of Science," 1851).

18. "On the Venomous Serpents of Georgia" ("Southern Medical and Surgical Journal," 1853).

19. "On the Descent of Glaciers" ("American Journal of Science," 1855).

20. "Review of Lieutenant M. F. Maury's Work on the 'Physical Geography of the Sea'" ("Southern Quarterly Review," 1856).

21. "The Mechanical Agencies of Heat" (ibid., 1856).

22. "Influence of the Study of the Physical Sciences on the Imaginative Faculties." An Inaugural Address, delivered December 1, 1857 (Columbia, S. C., 1858).

23. "Preliminary Researches on the Alleged Influence of Solar Light on the Process of Combustion" ("American Journal of Science," 1857; also, "Proceedings of the American Association for the Advancement of Science," 1857; and "Philosophical Magazine," 1858).

24. "On the Influence of Musical Sounds on the Flame of a Jet of Coal-Gas" ("American Journal of Science," 1858; "Philosophical Magazine," 1858).

25. "On the Optical Phenomena presented by the Silver Spring in Marion County, Florida (U. S.)," ("American Journal of Science," 1861; also, "Proceedings of the American Association for the Advancement of Science," 1860).

26. "On the Adequacy of Laplace's Explanation to account for the Discrepancy between the Computed and the Observed Velocity of Sound in Air and Gases" ("Philosophical Magazine," 1864).

27. "Limiting Velocity of Meteoric Stones reaching the Surface of the Earth" ("Nature," 1871).

28. "Vital Statistics: Illustrated by the Laws of Mortality from Cancer" ("Western Lancet," 1872).

29. "Heat generated by Meteoric Stones in traversing the Atmosphere" ("Nature," 1872).

30. "The Nebular Hypothesis" ("Popular Science Monthly," 1873).

31. Articles on "Bonanza," "Comstock Lode," and "Death Valley," in "Johnson's Cyclopædia," vol. iv, Appendix, 1876.

32. "Mars and his Moons" ("Popular Science Monthly," 1879).

33. "Origin and Distribution of Lakes; Meteorology of the Pacific Coast" ("Mining and Scientific Press" and Supplement, 1880–'81).

34. "Influence of Modern Methods of popularizing Science" ("Berkeleyan," 1882).

35. "Sound-Shadows in Water" ("American Journal of Science," 1882; also, "Philosophical Magazine," 1882).

36. "Origin of Jointed Structures in Undisturbed Clay and Marl Deposits" ("American Journal of Science," 1882).

37. "Apparent Attractions and Repulsions of Small Floating Bodies" ("American Journal of Science," 1882; also, "Philosophical Magazine," 1882).

38. "Amount of Carbon Dioxide in the Atmosphere" ("Philosophical Magazine," 1882).

39. "Physical Studies of Lake Tahoe" ("Overland Monthly," three papers, 1883–1884).

40. "The Part played by Accident in Discoveries" ("Berkeleyan," 1884).

41. "Horizontal Motions of Small Floating Bodies, in relation to the Validity

and Postulates of the Theory of Capillarity" ("American Journal of Science," 1884; also, "Journal de Physique," 1885).

42. "Criticism of Bassnett's Theory of the Sun" ("Overland Monthly," 1885).
43. "The Evidence of the Senses" ("North American Review," 1885).
44. "The Metric System" ("Overland Monthly," 1885).
45. "Thought Transference" (ibid., 1885).
46. "Barometer Exposure" ("Science," 1886).
47. "Electrical Phenomena on a Mountain" (ibid., 1887).
48. "Standing Tiptoe; a Mechanical Problem" (ibid., 1887).
49. "Vital Statistics, and the True Coefficient of Mortality, illustrated by Cancer" ("Tenth Biennial Report of the State Board of Health of California," 1888).
50. "The Decadence of Truthfulness" (1889).

About fifty additional papers are omitted from this list.

CORRESPONDENCE.

THE MENTAL BIAS OF WITNESSES.

Editor Popular Science Monthly:

IN the recent controversy between Prof. Huxley and Dr. Wace, I was struck by the fact that the latter does not seem to have seen that the truth of the gospel narratives is not so much a matter of literary criticism as of psychological criticism. Though M. Renan prove, with stronger arguments than Dr. Wace attributes to him, that the Gospel of St. Mark was written by an eye-witness, the doubt still remains as to whether the eye-witness could be trusted. We all know that even in this age, from which superstition is supposed to have been eliminated, people can not always be trusted to give an exact account of what they have seen; and how much more would this be likely to be true of the imaginative Oriental! "All the vaporing," as Dr. Wace calls it, "about the great critical operation of the present century" in "Robert Elsmere" is in reference to this point, *the value of human testimony*—not whether such a one wrote at such a time, but just how much he was influenced, when he did write, by his psychological tendencies, and also by the traditions of which he, in common with his fellow-men, was the heir.

When we find in the ancient religions of India, Persia, and Egypt exactly the same supernatural elements that we find in the gospel stories, and sometimes even a resemblance in details, such as there is between certain points in the life of Krishna and of Christ, we can not help drawing the conclusion that these supernaturalisms were, in their essence, survivals from older religions, and, in their attachment to the life of Christ, were a proof of the psychological tendencies of the people of that time toward supernaturalism; but that such conclusions should in any way affect the sincerity of Christ himself is perfectly absurd. Dr. Wace thinks that, unless Christ were what he is claimed by orthodox Christians to be, he would be perjuring himself, for example, in the Lord's Prayer, by addressing "our Father," which must show that he was aware of a special connection between God and himself; it neither shows a special connection nor hypocrisy on the part of Christ, but is a most natural form of expression. Even in the hymns of the "Rig-Veda," probably forming the oldest book in the world, men worshiped Dyaus-Pitar (Heaven-Father), so the conception of "our Father who art in heaven" is far older than the time of Christ. Through the unbiased study of comparative religion—a far better way to arrive at the truth than the study of literary criticism—the figure of Christ is made to stand out as the greatest revealer of absolute truth; and the supernatural elements which have been welded into his gracious life, refined of trivialities which attached to them in other religions, are but the attempt of the human mind to clothe in fitting outward symbol the truth which springs from within.

HELEN A. CLARKE.

PHILADELPHIA.

WHY NOT "COBBLE-UP" THE HUMAN BODY?

Editor Popular Science Monthly:

THE loud trumpeting of Dr. Brown-Séquard's alleged discovery of an "elixir of life" suggests another still more rational and practicable way of securing immortality, accompanied by youth and beauty, which I am amazed that no eminent surgeon has as yet made a bid for fame by proposing. We are all familiar with the brilliant feats of modern surgery in replacing damaged portions of the human body by sound and healthy parts obtained elsewhere. Autoplasty is one of the wide-reaching benefactions of science. Scalped mill-operatives have been furnished with good-as-new *chevelures* by piecemeal contributions from the heads of accommodating friends. Mangled eyes have been successfully replaced by healthy ones taken from cats and rabbits. For centuries the victims of Oriental despotism have had their noses and ears restored by the skilled "leeches" of India, Turkey, and Persia. So common have become operations for the restoration of noses, eyelids, ears, lips, palates, and tracheæ, that each of these has received a distinct name in medical literature. Nor have the surgeons stopped with these external organs, but have boldly invaded the interior of the system; and I think it is on record that one surgeon succeeded in saving his patient's life by patching up his cæcum with the intestines of a sheep

Why is not this idea capable of indefinite expansion? We all know that, as a rule, men do not break down like the "Wonderful One-Hoss Shay," which

> "went to pieces all at once—
> All at once, and nothing first—
> Just as bubbles when they burst."

Almost invariably they die from the wearing out or lesion of some one organ.

Now, anatomists tell us that we have not a muscle, nerve, or organ which is not duplicated in some one of the lower animals. This being the case, what is to prevent the skillful surgeon, when he finds that one of his patient's viscera—cranial, thoracic, or abdominal—has become incapable of performing its functions, on account of wearing out or weakness, from removing it, and substituting a brand-new one from some healthy and high-bred animal?

For example, instead of using the pancreatic juice of the lower animals, as Dr. Brown-Séquard proposes, why not transplant the organ which produces it, and thus insure the patient a never-failing supply of the digestive fluid produced on the spot? When a man's pancreas becomes debilitated from years of unremitting toil with fried pork and mince-pies, and goes on a strike, threatening stoppage of all other bodily functions and death, why not skillfully excise it, and put in its place, say, the pancreas of a goat or a pig? The wound heals by first intention; the man's digestion recovers the tone of his boyhood days; the food his wife cooks tastes as well as "the things mother used to make"; existence again becomes sweet music, and he takes a new lease of life, until some other organ breaks down, which can be similarly replaced.

So, on the simple plan of the old lady who made a pair of stockings last a lifetime by knitting on new feet one year and new legs the next, men can readily attain the age of Methuselah, with no other drawbacks than periodic recoveries from surgical operations, which will be no worse than their customary "spells of fever," "attacks of indigestion," "nervous prostration," "malarial poisoning," and the like.

I have endeavored to treat this important subject with proper scientific gravity. I anticipate, however, the ghoulish glee of the professional humorist, who will gloat over the prospect of prominent citizens being alluded to as "well-repaired" instead of "well-preserved" men, and who will give the overworked stove-pipe, mother-in-law, and front gate a rest, in order to exploit the funny possibilities of a mature gentleman who has been patched up until he has the digestive apparatus of a goat, the vocal and respiratory machinery of a donkey, and a cranial cavity filled with the ganglia of a sheep or an intelligent Newfoundland dog.

I anticipate also the moral and scriptural objections of a part of the clergy, as to the effect upon the soul of this incorporation with the beasts of the field.

But all great ideas must encounter this sort of thing, and so mine must perforce endure it. JOHN MCELROY.

WASHINGTON, D. C.

THE RIGHT TO PROPERTY.

Editor Popular Science Monthly:

IN Mr. Philpott's able essay on "The Origin of Property," in the "Monthly" for September, he quotes Prof. Leslie's notable remarks on the true meaning of the word "property." While there may have been others who have also called attention to the same point, I can not refrain from specially referring Mr. Philpott and your readers to Volume II of the works of the late Thomas Hill Green, a thinker whose acute and lucid discussion of fundamental political notions has received singularly inadequate notice. He frequently touches bottom ground with a firmness characteristic of no other political writer known to me, and in this instance he phrases with especial felicity (Vol. II, "Principles of Political Obligation," pp. 517 *et seq.*) the idea upheld by Mr. Philpott and Prof. Leslie: "Two questions are apt to be mixed up which ought to be kept distinct. One is the question how men came to appropriate; the other, the question how the idea of right has come to be associated with their appropriations. . . . One condition of the existence of property, then, is appropriation. But another condition must be fulfilled in order to constitute property. This is the recognition by others of a man's appropriations as something which they will treat as his, not theirs, and the guarantee to him of his appropriations by means of that recognition . . . (p. 522). To say that it is a 'law of nature' that a man should have a property in the work of his hands, is no more than saying that that on which a man has imposed his labor is recognized by others as something which should be his, just as he is recognized by them as one that should be his own master. . . . It is only within a society, as a relation between its members, that there can be such a thing as a right, and the right to free life rests on the common will of society. Just as the recognized interest of a society constitutes for each member of it the right to free life, so it constitutes the right to the instruments of such life, and thus through the medium, first of custom, then of law, securing them to each." This is Prof. Leslie's thought in amplified form, and it may be of interest to Mr. Philpott to note the passage.

John H. Wigmore.

Cambridge, Mass., *September* 14, 1889.

EDITOR'S TABLE.

A MINORITY BUT NOT A SECT.

A PROTESTANT minister in Oakland, Cal., in a recent address on the subject of the public-school system of the United States, expressed himself as follows: "In one of the schools of San Francisco Herbert Spencer's 'Data of Ethics' was introduced as a text-book of morals—as palpable a violation of the law forbidding sectarian instruction as the introduction of the Catholic or Methodist catechism; for Herbert Spencer belongs to that very small and narrow sect which promulgates the creed of agnosticism." If the reverend speaker had taken the ground that the "Data of Ethics" was too abstruse a book to be placed in the hands of public-school pupils, we should have felt inclined to sustain his objection. But when he says that to introduce such a book is to give a sectarian character to the school in which it is used, we must enter a protest. Science is never sectarian; philosophy is never sectarian. Sectarian teaching begins when you ask a man or a child to assume what can not be proved, for the sake of keeping within the dogmatic lines that fence round some particular creed. The followers of Mr. Spencer may be a minority, but they are no more a sect than were the adherents of the Copernican system of astronomy, or than are the believers in the Darwinian theory of natural selection. Mr. Spencer makes no appeal to faith, but finds his premises in the common experience of mankind. A pupil who was being taught out of the "Data of Ethics" would be quite at liberty to dispute either the premises or the arguments of the author; and he would not be silenced by the declaration that Mr. Spencer was infallible. But when catechisms are taught they are taught, not as containing matter for discussion, but as containing doctrines that must not be disputed, on pain of more or less disagreeable consequences. Similarly, when the Bible is read in school, it is read not as a fallible record of events or a fallible guide in morals, but as something absolutely authoritative—the very voice of God. It is perfectly obvious, then, where sectarianism in education begins: it begins just at the point where doctrines of any kind, accepted on faith by a portion of the community and not discussible on grounds of reason, are made a part of public-school instruction. Sectarianism comes in whenever the teacher is obliged to say "Hush!" to the inquiring scholar who wants his reason satisfied before he will believe. There is no sectarianism, on the other hand, in making use of a book which lays no claim to any kind of privilege, and which, therefore, can not force the belief of any one. The followers of Mr. Spencer do not form a sect, because they have no beliefs which they wish to exempt from criticism or discussion, and because they hold themselves at full liberty to pass beyond the bounds of Mr. Spencer's thought whenever they can see their way to doing so. Mr. Spencer's "Data of Ethics" may not contain all the truth on the subject of morals, but the truth which it does contain lends itself to demonstration; and no one can be the worse for being taught demonstrable truths. Upon that foundation he can afterward build what he likes—hay, stubble, or what not; and after his superstructure has been tried by the fire of experience, as it is very likely to be, he will still have something solid left on which to rebuild in perchance wiser fashion. We do not advocate the introduction of the "Data of Ethics" into the public schools; but we are convinced that it would be a very good thing for the rising generation if some of the ideas contained in that book could be brought home to their minds.

SCIENCE IN DOMESTIC ECONOMY.

Mr. Edward Atkinson's paper on "The Art of Cooking," which opens this number of the "Monthly," is one to which we confidently call the attention of every reader of the magazine. There is no art which concerns the well-being of more persons than cookery. Blunders in navigation do not injure those who stay on land, errors of engineering may easily be escaped, and the mistakes of the apothecary do not affect him who takes no medicine. But none of us can do without eating, and if our food is not properly prepared we are sure to suffer both in health and in pocket. The fact which Mr. Atkinson states in his opening sentence, that "the cost of materials which are used for food comes to one half or more of the average income" of most persons, shows the importance of carefully limiting the percentage of waste in this large item of domestic expenditure; and when we remember that, as he states in the next paragraph, "good health depends in greater measure upon adequate nutrition and upon the conversion of food material into a digestible form than upon any other factor in life," the value of correct principles in cookery, on the score of health, is apparent. Yet the present mode of cooking is far from agreeing with correct principles.

Mr. Atkinson says that almost the whole of the fuel used in cooking in the ordinary way is wasted, while the odors which accompany the process are evidence that the food is losing nutritious properties, and often that it is being converted into an unwholesome condition. The effect of heat on starch, sugar, fats, and albuminoids, and the laws of radiation and conduction, are well enough understood, yet cookery has remained stagnant, while metallurgy, dyeing, soap-making, and other familiar arts, which likewise depend on chemistry and the science of heat, have made gratifying progress. The cooking of the world is practically in the hands of women, and the art is in an undeveloped state. Here is a chance for the sex to prove good their claim to the same mental capabilities as men. Let them give up blind following of recipes and learn to understand processes. Let them experiment, record observations, and invent. If they can not at once rise to the level of original work, let them at least study the investigations and apply the inventions of others. Mr. Atkinson has made experiments in cooking, extending over some years, which have led to the invention of the apparatus described in his article. His "oven" and "cooker" unquestionably prevent the scorching of food, and effect a wonderful economy in fuel, yet he has found it difficult to give away his valuable ideas to the public. We are confident, however, that his article will be read with more interest than, say, twenty years ago. A steadily growing amount of thought is being given to making science serviceable in the preparation of food, and in other matters of household economy. The fact that such men as

Mr. Atkinson and Prof. Mattieu Williams are working in this field, and that their results are received with interest, gives promise that the human race will some time attain to a thoroughly intelligent style of daily life.

LITERARY NOTICES.

The Structure and Distribution of Coral Reefs. By Charles Darwin. Third Edition, with an Appendix by Prof. T. G. Bonney. With Illustrations. New York: D. Appleton & Co. Pp. 344. Price, $2.

The formation of coral reefs was one of the subjects investigated by Darwin during the voyage of the Beagle. The information which he obtained from his own observations and the reports of other investigators, together with the mode of accounting for these structures resulting from his study of this material, are embodied in the present work. The first edition of the book was published in 1842, a brief sketch of the author's views having been read in 1837 before the Geological Society, of London, and published. Darwin's theory of coral reefs speedily won acceptance among men of science, and had been taught in scientific lectures and text-books for a generation before any considerable rival appeared. In 1874 Darwin issued a revision of his book, containing additional facts obtained by later explorers. The only important work on the subject which had appeared since 1842 was Prof. James D. Dana's "Corals and Coral Reefs," issued in 1872. Prof. Dana had accepted Darwin's theory in the main, though objecting very decidedly to some of its minor features. In 1880 Mr. John Murray, one of the naturalists of the Challenger Expedition, advanced a theory widely at variance with that of Darwin, which has found vigorous supporters, and various modifications of both the leading hypotheses have been offered by later investigators. But the majority of those qualified to judge of this difficult question have shown a disinclination to give up Darwin's theory for that of Murray—so much so that the Duke of Argyll, evidently jealous for Scottish honor, in 1887 accused scientific men of disregarding Murray's work from subserviency to their idolized Darwin. The duke's article was entitled "A Conspiracy of Silence," and drew forth a vigorous reply from Prof. Huxley in the review in which it appeared, besides arousing a spirited discussion in the columns of "Nature." The new edition of "Coral Reefs" affords the means of forming an intelligent opinion as to the merits of Darwin's views. It is, by the way, the first edition that has been published in this country. The body of the work has been left as revised by the author for the second edition, but occasional foot-notes, and an appendix comprising a careful summary of the more important memoirs published since 1874, have been added by Prof. T. G. Bonney. In the first three chapters the three chief classes of coral formations—atolls or lagoon islands, barrier reefs, and fringing or shore reefs—are described. The fourth chapter deals with the distribution of coral reefs and conditions favorable to their increase, their rate of growth, and the depths at which reef-building corals can live. Darwin's theory of the formation of the different classes of coral reefs then follows. Coral polyps do not flourish below a depth of twenty or thirty fathoms, but reefs are found rising from much greater depths—how are these to be accounted for? The theory regards barrier reefs and atolls as having been developed successively from fringing reefs. The latter are so named because they closely skirt the shores of islands and continental land, increasing by growth on the outer edge, where the conditions seem to be most favorable for the life of the corals. Imagine such a reef formed around a volcanic island, and the island then to begin sinking beneath the sea. The reef will be carried down with it, but the active growth at the outer edge will still keep this part at the sea-level, while the inshore part where growth has stopped will become deeply submerged. We now have an island surrounded by a deep channel, outside of which is a ring of coral—that is, an island encircled by a barrier reef. Suppose the subsidence to go still further until the highest point of the island disappears, the growth at the outer edge of the reef still keeping it up to the surface, and there results a ring-shaped reef inclosing a lagoon—that is, an atoll. It can not be denied that this theory accounts for the channel within a barrier reef and the ring shape of atolls, besides answering the question asked above, all in a very natural way. But it has been objected to on account of the amount of subsidence in the floor of the Pacific and Indian Oceans which it would imply, and for other reasons. Mr. Murray attempts to find a foundation at a suitable depth for the corals to begin work upon without supposing subsidence. He thinks this could be furnished by the accumulation of skeletons of minute animals and plants, upon natural elevations of the sea-floor, although when such remains fall to greater depths they are mostly dissolved by the aid of the carbon dioxide in the water. He thinks that a coral plantation rising on such a base would tend to assume the atoll form owing to the more abundant supply of food to the outer portions, and the removal of dead coral rock from the inner portions by the force of currents and by solution. He believes that barrier reefs have been built out from the shore, and that the channel within them is hollowed out by the same agencies as the lagoon of an atoll. The death of Darwin occurred so soon after the promulgation of this theory that he did not have an opportunity to publish any examination of it, but to a friend, Mr. T. Mellard Reade, who had expressed the opinion in a letter that it was "a very far-fetched idea," he replied: "I am not a fair judge, but I agree with you exactly that Murray's view is far-fetched. It is astonishing that there should be rapid dissolution of carbonate of lime at great depths and near the surface, but not at intermediate depths where he places his mountain-peaks." Besides a statement of Murray's theory, Prof. Bonney's appendix contains abstracts of the views of Alexander Agassiz, H. B. Guppy, G. C. Bourne, Bayley Balfour, W. O. Crosby, and J. D. Dana, together with an expression of his own opinion as to the value of the various objections to Darwin's theory. The volume contains three folded charts, and has an adequate index. It is bound uniformly with the other works of Darwin issued by the same publishers.

NATURAL RELIGION. By F. MAX MÜLLER. London and New York: Longmans, Green & Co. Pp. 608. Price, $5.

THIS book includes the first course of Gifford lectures, twenty in number, delivered by Prof. Müller before the University of Glasgow in 1888. The Gifford lectures rest upon a fund of eighty thousand pounds which was left by Lord Adam Gifford by will in 1885, to be applied in specific sums to the establishment in four Scotch universities of chairs for "Promoting, advancing, teaching, and diffusing the study of Natural Theology," or "the knowledge of God, the Infinite, the All, the first and only cause, . . . the knowledge of his nature and attributes, the knowledge of the relations which men and the whole universe bear to him, the knowledge of the nature and foundation of ethics or morals, and of all obligations and duties thence arising." The will provided for changes of lecturers at short intervals, so that the subject might be presented by different minds; that no tests should be required of them save that they be "able, reverent men, true thinkers, sincere lovers of and earnest inquirers after truth"; and that they should treat their subject as a strictly natural science, and under no restraint. Prof. Müller's course naturally assumes the character of an introduction to the courses that are to follow. Much of it is therefore given to laying down the lines and adjusting the bearings; and the discussions comprised in it touch chiefly upon the three points of the definition of natural religion; the proper method of its treatment; and the materials available for its study. The definition is found in the seventh lecture to be, "Religion consists in the perception of the infinite under such manifestations as are able to influence the moral character of man." Of methods, the historical is preferred as the one most likely to lead to results of permanent value. Its object is to connect the present with the past, to interpret the present by the past, and to discover, if possible, the solution of our present difficulties, by tracing them back to the causes from which they arose. It has to be, and is, defended against the common misapprehension that the historian cares only about facts, without attempting to interpret them; and against the opposite school of philosophers who think that our own inner consciousness is the one and only source from which to draw a knowledge and understanding of natural religion—forgetting that their inner consciousness "is but the surface of the human intellect, resting on stratum upon stratum of ancient thought, and often obscured by thick layers of dust and rubbish, formed of the detritus in the historical conflicts between truth and error." The materials for the study are language, myths, customs and laws, and sacred books. In pursuing it, the subject is divided into three branches, according as what is here called the Beyond or the Infinite was perceived, in nature—Physical religion, which was to be the subject of the next course of lectures; in man—Anthropological religion, which meets us again and again in different ages and in widely distant parts of the world; or in the self—Psychological religion, filled with intellectual endeavors after that which lies beyond man, as a self-conscious subject. The last statement corresponds in the Christian religion with the doctrine of the Holy Ghost, by which was meant in the beginning "the Spirit which unites all that is holy within man with the Holy of Holies, or the Infinite beyond the veil of the Ego, or of the merely phenomenal Self."

A Manual of Machine Construction for Engineers, Draughtsmen, and Mechanics, embracing Examples, Rules, Tables, and References. By John Richards. Philadelphia: J. B. Lippincott Company. Pp. 306. Price, $5.

The author of this book enjoys the advantage of an experience of thirty-five years in constructive engineering work, at home and abroad. He is a practical mechanic in metal and wood work, and a designer and constructor of machine-work of all kinds. He has prepared original designs for more than a thousand machines now in common use in America and Europe, and is the author of many papers and a number of valuable treatises on various mechanical subjects. The present work is practical; is not for instruction so much as for direct application, and is intended to meet the every-day wants of the engineer, draughtsman, and mechanic in his workshop. The tables are the result of actual practice, and are worked out from complete drawings. The references are such as are constantly required in real work, and the selection is made by noting for a number of years the relative frequency of references to the different subjects. In points of material content and arrangement, each alternate page is left blank, so as to leave a place for receiving the owner's notes and original matter, the constant accumulation of which will, it is believed, make the work a valuable *vade mecum*. There are other conveniences in arrangement, designed to facilitate the use of the book and the finding of the page, besides helps to the reduction of values. In the general introductory observations, the possibility of determining between what is computable and what not, is considered. Among the particular subjects of the chapters are: "Machine Design," "Bearings for Shafts and Spindles," "Sliding Bearings," "The Transmission of Power," etc., "Steam Machinery" with its details; "Hydraulics," "Mechanical Draughting," "Heat," "Dynamics," "Properties of Materials"; and "Weights, Measures," etc.

The Federal Government of Switzerland. By Bernard Moses, Ph. D. Oakland, Cal.: Pacific Press Publishing Company. Pp. 256. Price, $1.50.

This volume, by the Professor of History and Political Economy in the University of California, comprises a carefully prepared essay on the Constitution of the principal established European republic; one that may give lessons to American citizens, and which is in every way worthy of their study. Prof. Moses approaches the subject with the manner of one who understands it, and treats it philosophically and judiciously, not only describing the provisions of the Swiss Constitution, but investigating their evolution, and finding how they came to be there. In the introduction, having considered the physical conditions of Switzerland and observed the composite character of its population, he draws a contrast between it and the American republics—the United States and those of Spanish origin. The population of Switzerland, various as it is, has grown from prehistoric stock without serious disturbing influences. The populations of the American republics have been formed from elements whose later environment has had little in common with their earlier surroundings, and under conditions where the force of ancient traditions has been weakened by long migrations. Switzerland and the British colonies were predetermined to federation by their geographical positions. Switzerland is the only existing republic that has lived through the period in which religious wars were a part of the order of the day. Notwithstanding this, and the sharp religious divisions between the cantons, union has prevailed, and a federal government has been established under which both Catholics and Protestants live without serious friction. Another peculiar feature of Switzerland is the prevalence of three distinct and official languages (besides the unofficial Romansch), and the maintenance of as many national characteristics, while in the United States there is a tendency to assimilation in all things of thiskind. The negro in the South introduces a problem into our political life "of which the population of Switzerland gives no hint." Such class distinctions as may exist there are those that may arise in a homogeneous society under the conditions of modern life, or are a survival from the feudal age; but "they are not such as proceed from the existence in the population of different races regarded as inferior and superior." Illiteracy and general ignorance in any part of the population are wanting in Switzerland; "in fact, in no country of the world are the affairs of education administered more zealously or with greater efficiency. The problem of republican government is, therefore, simpler in Switzerland than in America, in spite of the proximity of the Swiss to the monarchical rule of European states." The analysis of the Swiss Constitution is introduced by a review of the "Antecedents of Swiss Federalism," and is applied in succession to the several departments of the government, its foreign and internal relations, the army and finance, "Rights and Privileges," and "The Common Fraternity."

Kant's Critical Philosophy for English Readers. A New and Completed Edition. By John P. Mahaffy, D. D., and John H. Bernard, B. D. Vol. II. The Prolegomena translated, with Notes and Appendices. London and New York: Macmillan & Co. Pp. 239. Price, $1.50.

This is the second volume of a work whose first volume was noticed in this magazine several months ago. While in the preceding part of this work the editor has taken the more agreeable task of paraphrasing the original, because the "Kritik" is already accessible in English, he has deemed it "due to Kant to put his 'Prolegomena' in all their homeliness literally before the reader." He has reprinted in the appendix the suppressed passages of Kant's first edition of the "Kritik." The work is unfortunately without an index.

The Modern Chess Instructor, Part I, by *W. Steinitz* (G. P. Putnam's Sons), contains elementary explanations for beginners, the description of notations, a telegraphic chess code, an essay on the principles of the game, and analyses of six popular openings, with illustrative games to each opening, while the appendix contains the games of the contest between Messrs. Steinitz and Tschigorin which were played at Havana in January and February, 1889, with annotations by the author. Pp. 193. Price, $1.50.

Prof. *Charles W. Kent*, of the University of Tennessee, has prepared an edition of the old English poem *Elene*, which is ascribed to Cynewulf, with introduction, Latin original, notes, and a complete glossary. The introduction and notes are designed for the use of students, and not with any view to critical purposes. The glossary has been made more complete than is usual in editions of old English poems. From the historical notice in the introduction, it appears that the manuscript of this poem was found in 1822 in the Cathedral Library in Vercelli, and the question of the way it got there has given rise to considerable discussion, with not very definite results. The author is supposed to have been a Northumbrian, and to have lived in the eighth century. The poem is founded on the story of the search for the cross and its discovery by the Empress Heléna, wife of Constantine. While the author has followed the story with considerable fidelity, he has not bound himself too closely to it, and those passages which are all his own are the best in the work. Besides the historical and critical introduction, a metrical introduction and a bibliography are given. We last month published a notice of a translation of this and two other old English poems. Ginn & Co., publishers. Pp. 149. Price, 65 cents.

Of two text-books in Greek published by Ginn & Co., Mr. *Isaac Flagg's* edition, with notes, of Euripides's *Iphigenia among the Taurians* commends itself, not only on account of the superlative literary merit of the tragedy, but also for the editor's excellent critical introductions, in which he gives an account of the growth of the legend of Iphigenia, an analysis of the plot and artistic structure of the work, and a dissertation on the meters and technique. The volume is one of the publishers' "College Series of Greek Authors," edited under the supervision of J. W. White and T. D. Seymour. Pp. 197. Price, $1.50.—Mr. *Addison Hague's Irregular Verbs of Attic Prose* gives, after the regular verbs, pure, mute, and liquid, the irregular verbs in alphabetical order, with prominent meanings and special uses of frequent occurrence, often illustrated by translated examples, the most important compounds, many related words, and some four hundred and fifty English derivatives. The volume constitutes a helpful bridge over a most difficult passage in the study of Greek. Pp. 268. Price, $1.60.

Prof. *S. E. Tillman's Elementary Lessons on Heat* (J. B. Lippincott Company) have been prepared to meet the necessities of a short course of seventy hours at the United States Military Academy. The selection of material has been guided by considerations of the sub-course of studies and of what is essential and most useful for the students to know. A logical arrangement is sought, and clearness and conciseness in relation are aimed at. Most of the experimental illustrations described or referred to are such as can be performed in the lecture-room. The special topics treated of are "Thermometry," "Dilatation of Bodies," "Calorimetry," "Production and Condensation of Vapor," "Change of State," "Hygrometry," "Conduction," "Radiation," "Thermo-Dynamics," and the "Meteorological Aspects of Heat." Pp. 160. Price, $1.80.

The *Manual of Chemistry for the Use of Medical Students* of Dr. *Brandreth Symonds* (P. Blakiston, Son & Co., Philadelphia) is not designed to be a medical chemistry, but takes up those parts of general chemistry which it is necessary for medical students to know. The author, having prepared students for several years in this branch, believes that he knows their needs, and has made this effort, in the light of that knowledge, to supply them. Besides the elements, a large share of the space is allotted to the chemistry of water and air and the substances by which they are polluted; and for this acknowledgment is made to the lectures and articles of Prof. C. F. Chandler. A chapter is given to the tests for the important substances, and another chapter to the tests for urine and the substances that occur in it. The theories of to-day concerning chemical action are briefly presented. The metric weights and measures are also noticed, and the rules are given for converting degrees of temperature. Pp. 154. Price, $2.00.

In an attractive-looking volume of convenient pocket size, entitled *Great Words from Great Americans*, G. P. Putnam's Sons have grouped the Declaration of Independence, the Constitution of the United States, Washington's inaugural and farewell addresses, Lincoln's inaugural and farewell addresses and his great Gettysburg speech, and Washington's circular letter of congratulation and advice to the Governors of the thirteen States, with historical notices on some of the papers, and portraits of Washington and Lincoln. These papers all embody principles and enunciate truths the observance of which is essential to the maintenance of our Government, and which it is important that all citizens should cherish and keep in vigorous life. Pp. 199. Price, 75 cents.

The Kingdom of the Unselfish; or, the Empire of the Wise (Empire Book Bureau, 28 Lafayette Place, New York), has been written by Mr. *John Lord Peck* with reference to the existing stage of social evolution. If not suited to the present state of opinion, it may find a reading in the next century. The purpose of the book is unfolded in the introductory chapter, which is headed "The Reliable and Unreliable in Thought." Of the unreliable are all religious systems founded on tradition and revelation, dogma, and speculative philosophy, including all the systems that have followed one another from Plato and the ancients down to the pessimism of Schopenhauer and Hartmann and the agnosticism of Comte, Huxley, and Spencer. Neither of these last systems "is sufficiently near the final truth to long satisfy the human mind, and the prediction is here ventured that both of them will give way to a system of ontology more perfect than the evolution philosophy as represented by Herbert Spencer." The class of ideas that is most positive and reliable is found in modern science, which acknowledges nothing as beyond candid criticism, has nothing sacred but the truth, and investigates every part of the universe and of man with equal impartiality; and is not an extreme or antagonistic of all former knowledge and opinion, but "is a more complete, thorough, and systematic knowledge of the same kind as any imperfect knowledge preceding it that has a real basis of fact."

The second volume of the *Report* for 1888 of the Geological Survey of Arkansas, under the direction of State Geologist *John C. Branner*, comprises a review of the *Neozoic Geology of Southwestern Arkansas*, by *Robert T. Hill*. It is the result of the joint work of the United States and the State Surveys, in which the latter was able to avail itself of Prof. Hill's knowledge of the mesozoic geology of other parts of the Union. The region embraced in the present survey may be said roughly to lie between the Ouachita and Red Rivers, extending a little east of the Ouachita, including Little Missouri and Little Rivers, and to consist most largely of the Trinity, Lower and Upper Cretaceous, and Tertiary formations, with plateau gravel and associated deposits, and the flood plains of the rivers, of the Post-tertiary or Quaternary. In determining the relations of the Upper Cretaceous beds, the author concludes that they are identical with those of Texas, more obscurely so with those of New Jersey, and the equivalent of the Upper Cretaceous of Europe. The relations of the Lower Cretaceous and Trinity with formations east of the Mississippi are at present only conjectural. Prof. Hill's review is supplemented by papers on "The Northern Limits of the Mesozoic Rocks in Arkansas," by Prof. O. P. Hay, and "On the Manufacture of Portland Cement," by Prof. Branner. —The third volume of the series is a preliminary report on the *Geology of the Coal Regions*, by *Arthur Winslow*. It contains only a part of the coal regions of the State, representing an area of nearly two thousand square miles and extending about seventy-five miles along the Arkansas River from the Indian Territory to Dardanelle. Chapters are devoted to the "Distribution of the Coal," a review of the coal industry of the State, and the composition and adaptabilities of the coals.

The *Commissioner of Agriculture*, in his *Report* for 1888, represents the year as having been one of much greater activity in the department than it had ever before experienced. The investigations made have excited popular interest, and the results obtained have been helpful to the farming class. A good record was made of the work of the experiment stations. A clearing-house or exchange is called for through which they can co-operate. The most important duty devolving upon the Bureau was the work for eradicating contagious pleuro-pneumonia in cattle; and, in connection with this, the need of a laboratory is suggested where persons can qualify themselves by experiment for practice in the diseases of animals. The division of entomology pursued investigations on the cottony-cushion scale of California, the hop-louse, the root-infesting nematode worms, the cotton and boll worm, which attacked the tomato; the Rocky Mountain locust, the buffalo gnat, and various other insects injurious to vegetation. It is giving attention to the introduction of parasites destructive of such insects. Experiments of silk-culture have not yet given promise of a profitable industry. The chemical division interested itself in the study of food adulterations and processes for making sugar from sorghum. The statistical department had to meet large demands for supplying information. The botanical division was busy in experiments on the adaptation of various plants, and in studies in vegetable pathology. Attention was given to the habits of different birds, and the depredations on crops of various small mammals. The seed division was active in sending out seeds to experimental cultivators and the constituents of members of Congress. The forestry division reported progress, but not much encouragement as yet for the restoration of the forests, or even for the preservation of what of them are left. Microscopical investigations were made in various directions. In pomology experiments are reported on tropical and semitropical fruits and on hardy Russian fruits for the Northwest; and an excellent paper, by Mr. W. H. Ragan, is published on our wild fruits and the desirability and feasibility of perpetuating, cultivating, and improving them.

Sun and Shade is the name of a monthly "picture periodical without letterpress," published by the *Photo-Gravure Company*, 853 Broadway, New York, which has lately completed its first year. In its growth it has found the taste of its patrons preferring pictures of the higher class, and quality rather than quantity, and announces its purpose in the selection of subjects to respond to this demand. Among its plans for the future are to reproduce the leading pictures in the collection of the Metropolitan Museum of Art and the works of American artists; to encourage the artistic side of direct photography in all its phases; and to add examples of sculpture, architecture, and industrial art. The subjects of "Ecce Homo," "The Return," "Sunshine," "From the Land of Sleepy Hollow," and others, in the August number, each executed in its peculiar style, could hardly be improved upon. Price, 40 cents, a number; $4 a year.

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POPULAR MISCELLANY.

Ancient Aboriginal Mining.—Writing on "Ancient Mining in North America," Prof. Newberry speaks, in the "American Antiquarian," of the great antiquity of the aboriginal works. The ancient copper mines on Lake Superior were abandoned not less than four hundred years ago; for the heaps of rubbish around the pits made by the ancient miners were covered with forest trees that had reached their largest size. The old mica mines of North Carolina and the quarries of serpentine in the Alleghanies showed like evidences of antiquity. Some population in the Mississippi Valley worked the oil-fields in various places. The author, visiting Titusville in 1860, when the first well had been opened, noticed pits in the ground which proved to be relics of the excavations of primeval oil-gatherers. A citizen, digging a well in one of the pits, had discovered and followed an old well, which was cribbed up with timber and contained a primitive ladder, like those which have been found in the old copper mines of Lake Superior. The cribbing had been rudely done with sticks from six to eight inches in diameter, which had been cut or split by a very dull instrument, "undoubtedly a stone hatchet." The oil was probably gathered by being skimmed from the water that collected in the bottom of the pit. Traces of a similar well were observed at Enniskillen, Canada; and depressions in the surface like those on Oil Creek were noticed at Mecca and Grafton, Ohio. Ruins of an ancient lead mine exist on the Morgan farm, near Lexington, Ky., in the form, where they have not been disturbed, of an open cut, from six to ten feet wide, "of unknown depth, and now nearly filled with rubbish. On either side of this trench the material thrown out forms ridges several feet in height, and these are everywhere overgrown by trees, many of which are as large as any found in the forests of that region." Galena has been found in many of the ancient works in Ohio, but has never been smelted, and appears to have been valued merely for its brilliancy. Dr. Newberry does not believe that the mound-builders were of the present Indian stock.

The Law's Neglect of Children.—The defects of English law in regard to the rights and claims of children are pointed out by Mary C. Tabor in the "Contemporary Review." According to Chief-Justice Cockburn, no legal obligation is imposed on the father to maintain his children except under the poor-laws, or unless his neglect shall bring him under the criminal laws. Nor is there any obligation upon him to make provision for them after his death; but, on the other hand, he can by the appointment of guardians exercise almost as absolute a control over them in other respects as if he were living. Responsibility for giving a certain degree of instruction has been imposed by the late Education Act, which the father shares as to children born in wedlock, but as to illegitimate children he is scot-free. The mother of an illegitimate child may, it is true, recover from the father a sum for maintenance, but that obligation is in law due to her only, and in no way to the child itself, which "is shut out from even the shadow of a right to a father's care." The results of so defective a system are what might have been expected; the working of the Education Act, and of several benevolent enterprises in behalf of children, "have brought to light an appalling amount of semi-starvation, ill-treatment, or neglect, to which children are subjected with impunity at the hands of drunken, dissolute, or idle and improvident parents." Thousands of them do not get a single good meal a day, but come breakfastless to school, and their midday meal is provided by a charity. Cases of neglect and cruelty are brought before magistrates against which no statute provision can be found, so that one officer was driven to declare: "Had it been a dog, I could have helped you; but it is only a child, and I am powerless to assist." The want of paternal responsibility is what drives unmarried mothers to crimes against their offspring. What can they do with them in the situation in which they find themselves? In such cases the author would make the father of the child jointly liable. Matters are better in most of the American States, but in the majority of cases our own provisions lack enormously of what they ought to be. There are practical difficulties in the way of securing adequate protection by law which can not be overlooked; so that the best that can be done will be short of what is desired. But this only enforces the reasons for "doing the best that can be done."

Structure of the Ether.—"We seem," said Prof. Fitzgerald, in the British Association, "to be approaching a theory as to the structure of the ether. There are difficulties connected with diffusion in the simple theory that it is a fluid full of motion, a sort of vortex sponge. There are similar difficulties in the wave theory of light, owing to wave propagation round corners, and there is as great a difficulty in the jelly theory of the ether arising from the freedom of motion of matter through it. It may be found that there is diffusion, or it may be found that there are polarized distributions of fluid kinetic energy which are not unstable when the surfaces are fixed; more than one such is known. Osborne Reynolds has pointed out another, though in my opinion less hopeful, direction in which to look for a theory of the ether. Hard particles are abominations. Perhaps the impenetrability of a vortex would suffice. Oliver Lodge speaks confidently of a sort of chemical union of two opposite kinds of elements forming the ether. The opposite sides of a vortex ring might perchance suit, or may be, the ether, after all, is but an atmosphere of some infra-hydrogen element; these two latter hypotheses may both come to the same thing. Anyway, we are learning daily what sort of properties the ether must have. It must be the means of propagation of light; it must be the means by which electric and magnetic forces exist; it should explain chemical actions, and, if possible, gravity. On the vortex-sponge theory of the ether there is no real difficulty by reason of complexity why it should not explain chemical actions. In fact, there is every reason to expect that very much more complex actions would take place at distances comparable with the size of the vortices than at the distances at which we study the simple phenomena of electro-magnetism. . . The theory that material atoms are simple vortex rings in a perfect liquid otherwise unmoving is insufficient, but with the innumerable possibilities of fluid motion it seems almost impossible but that an explanation of the properties of the universe will be found in this connection."

The "Rabbit Pest" in Australia.—The prevalence of the "rabbit pest" in Australia seems to be largely a result of man's indiscreet interference with the order of nature. Hares were introduced for coursing. Pet rabbits were brought over, and a few pairs of gray rabbits were turned out near Geelong, to form a warren. The last lot are believed to have been the fathers of the mischief, although some of the traits of the pets are found among the pests. The rabbit army generally trends toward the north because it started from too near the ocean to advance south. Night travelers along the Murray River used to describe the noise made by the rabbits scampering off from the coach-lights as something like the pattering of a hail-storm. The colonists made a first mistake in having the dingoes, or native dogs, destroyed, because they were dangerous to the sheep. Then the kangaroos began to multiply, taking advantage of the accommodations provided for the sheep. As soon as they were reduced to manageable numbers, the rabbits appeared. The twenty or twenty-five million sheep pastured on the Riverina plains are being gradually eaten out by rabbits to an extent which is represented by the decline of the flocks supported at one station from one hundred and ten thousand to twelve hundred head. The rabbits at that station have eaten up and destroyed all the grass and herbage; have barked all the edible shrubs and bushes; and have themselves perished by thousands. Foxes have been introduced for the accommodation of hunters, and in the belief that they might help to keep down the rabbits, and have become an additional and fast-increasing nuisance. Mr. C. G. N. Lockhart, in "Blackwood's Magazine," advises that the rabbits be fought by the encouragement of their natural enemies, cats and iguanas. Cats hunt them industriously, and it may be estimated that the progeny of one pair of cats will in the fifth year be equal to the slaughtering in one year of two million and a half of them. Iguanas, in the growing scarcity of opossums, their proper food, may probably learn to eat rabbits. The bounties offered for the destruction of rabbits are actually contributing to their perpetuation. The professional trappers find them a profitable game, and take care to keep up the supply. Hence they make war upon the cats with much more anxiety for their extinction than they show against the rabbits.

The Fate of the Gulf Stream.—M. J. Thoulet, applying the results of some recent observations respecting the relative levels of sea-water, describes the Gulf Stream as like a river, having a crest-line more inclined in the vicinity of its source than toward its mouth; separated by a valley of relatively abrupt inclination from the southward Newfoundland current, while its right flank has a more considerable breadth. Certain currents from the Gulf of St. Lawrence strike it so as to retard its speed and cause the deposition as a submarine delta in the slope of the "banks" which extend along the United States from the Great Bank of Newfoundland; while the eastern polar current, passing around Newfoundland on the east, strikes it perpendicularly. The waters of this current, colder but a little lighter than those of the Gulf Stream, mingle with them, and almost stop it. Its warm waters then spread out, and although they still possess a general direction toward the east, are subject to the impulsion of the winds and other accessory causes affecting the economy of currents. The Gulf Stream is then in the best condition to mollify the climate of western Europe, but no longer has individuality; it has become a simple drift without depth, and may be compared to a great river lost in swamps.

Wild Creatures of the Alps.—Martens and eagles add to the charms of the landscape for the Alpine tourist, but are hunted by the forester as his special enemies. The marten is a great destroyer of eggs and weak young creatures, and even attacks roes during the heavy snows of winter. It steals along by the animal as it labors through the heavy drifts till it becomes exhausted, when he springs upon it, bites its jugular vein, and sucks its life away. The marten does not eat its game, but drinks the blood while it is still warm, and leaves the body for other beasts and the elements. The fox hunts in a similar way, but eats the flesh till it is satisfied, and buries the rest of the carcass. The foresters do not like to pursue their predatory enemies with poison and traps, because, it is said, "they seem to think that they are taking an unfair advantage of a brother sportsman by employing such underhand means of getting rid of him." Still, they will lie in ambush to shoot their rivals. Selecting a conveniently situated building, they attract the foxes toward it by scattering carrion around at a suitable distance. Having learned the hour at which the animals are accustomed to appear, they lie in wait for them, on some moonlight night, and shoot at the shadowy forms as they come in sight. The larger birds are shot in a similar manner, but under circumstances of more labor and discomfort, because they are more wary. While the fox can be waited for in a warm room, with the window closed, the birds have to be watched from some rugged spot where it is impracticable to have a fire, and with open windows. The birds are also hunted for with a decoy horned owl—a creature toward which they are hostile; and some of the foresters keep owls for this work. While the hunters hide in some shelter they have constructed, the owl is tethered upon a branch, with chain-room enough to enable him to reach and move about upon the ground; while a string is led from the chain to the shelter, by means of which the owl is kept in a lively condition. The fluttering of the bird between the ground and the perch attracts the attention of the crows; their circling and cawing are noticed by the hawks and eagles, which come around to see what the crows have found, and are shot.

Doctor and Patient in Ancient Hispaniola.—Some of the curious features and customs of the people which were described by the early travelers in Hispaniola or Hayti have been recalled by Mr. H. Ling Roth, in a paper before the Archæological Institute. The missionary Ramon Pane says that the doctors were dieted along with their patients, and were obliged to purge themselves when they did. Intoxicating himself by snuffing a powder which may have been tobacco, the doctor would say extravagant things. These were regarded as communications from the *Cemis* or fetich, and as embodying revelations of the origin of the sickness. Having put into his mouth a package of small bones and flesh and gone through some preliminary observances, the doctor would go toward the sick man and turn him twice about; then, standing before him, take him by the legs, feel his thighs, descending by degrees to his feet, and draw hard, as if he would pull something off; then, going to the door, he would shut it, saying, "Begone to the mountain, or to the sea, or whither thou wilt!" With this he would give a blast as if he were blowing something away, turn about, clap his hands together, and shut his mouth, while his hands would be quaking as if he were a-cold. Then he would blow on his hands, and drawing in his blast as if sucking the marrow of a bone, he would suck at various parts of the man's body. This done, after a coughing and making of faces, as if they had eaten some bitter thing, the doctor would pull out what he had put into his mouth before starting out. If it was anything eatable, he would tell his patient that the *Cemis* had put it into him to cause the distemper because he had not made a suitable offering to it. If the patient died, and his friends were strong enough to oppose the physician, they would mix with the juice of a certain herb and the dead man's nails and forehead hair pounded between two stones, and, pouring it down the dead man's throat and nostrils, ask him whether the physician was the cause of his death. This they would do till the dead man would speak, "as plain as if he were alive," and answer all that they asked of him, when they would return him to his grave. Another method of making the dead speak was to place the body over a very hot fire covered with earth, when the dead would answer ten questions and no more. If the physician had failed to do his duty, he was waylaid and bruised, but a particular mutilation was necessary to secure his death. At night, after the bruising, snakes were believed to lick the doctor's body, and he would tell the people that the *Cemis* had come to his assistance.

Country Life, Past and Present.—As to whether country life is more comfortable now than it was fifty years ago, something may be said on both sides. Most of the places remote from large towns were literally out of the world in the old times, so far as society and active life were concerned. Traveling by public conveyance was difficult, inconvenient, and expensive; and visits to the city were rarely enough made to be with many literally the event of a lifetime, while hosts of other persons never enjoyed them at all. Communication by letter even was not common, for postage was high and graduated according to the distance, and only those who were able to indulge in it as a luxury felt that they could afford to dispatch many letters except on business or in cases of necessity. There were market towns, and they enjoyed a kind of prosperity of their own from which many of them have fallen since railroads came in, and they had their societies and their peculiar codes and usages and games and amusements, which left no lack of sources of enjoyment. But very few now living in those same towns would exchange their present life there for that of the past. There were, however, a sociality and a heartiness in the neighborhood life of those days, a freedom and equality of intercourse among the people of all classes—an ignoring, in fact, of class distinctions—a community of feeling and reciprocal interest by all in the welfare of all, a wholesome public opinion, and an intelligent public spirit, that have now disappeared. Then Lincoln's ideal of government of the people, for the people, by the people, was realized in thousands of communities where the hope of it and even the imagination of it are not now entertained. We have gained that the value of which we can not calculate with railroads and telegraphs, and the changes which have come over our social life; but it is equally impossible to estimate what, in turn, we have lost.

Deep-Sea Fishes.—Remembering the darkness and the enormous pressure of the water in the depths of the ocean, no one will be surprised that the forms and the organs of deep-sea fishes differ greatly from those of species which live near the surface. Unless among microscopic creatures, no such curious and grotesque shapes can be found in the animal kingdom as among these fishes. Some resemble the ribbon-fishes of our own seas, being long and slender, like the scabbard of a sword. Others are fashioned after the type of our angler-fish, having organs about the mouth suggestive of a bait to attract its prey. Some terminate in a sharply pointed tail instead of the familiar form. One strange form is *Bathypterois longicauda*, of which one specimen only has been taken, from a depth of 2,550 fathoms in the middle of the South Pacific. This fish was three inches long, with a big head and tail and a very slender body. The uppermost pectoral fin was longer than the whole fish, and was forked from its middle. Some species have huge mouths with bodies like loose sacs, capable of prodigious distention when they seize upon a large victim. *Macrurus crassiceps* has a huge head with hardly any body. The hues of deep-sea fish are mostly simple. Their bodies are either black, pink, or silvery; though some which are black when preserved were blue on being brought to the surface. In only a few are some filaments or the fin rays of a scarlet color. Black spots on the fins or dark cross-bars on the body are of extremely rare occurrence. Few people are aware how difficult it is to procure the deep-sea fishes. Their tissues are extremely delicate, so that the dredge often mutilates them. Frequently, too, in coming up from the bottom, on the pressure gradually growing less, the gases which they contain, expanding, tear their way out. Especially is this the case with those which possess a swim-bladder. This is almost always ruptured as the fish comes to the surface. Indeed, some specimens have been found floating in a dying state on the waves, from having seized upon prey which was too powerful for them, and in struggling to escape dragged them into the upper waters, when some rupture took place and they floated helplessly to the surface. The most curious part of the organization of deep-sea fishes is undoubtedly the phosphorescent or luminous organs which distinguish several well-known species. In some of these the eyes seem entirely absent or only rudimentary. Thus, *Ipnops Murrayi*, taken from a depth of 1,600 to 2,150 fathoms, possesses no eyes. It has a depressed head, with a broad snout, and the upper surface of the head is covered with a pair of transparent membranes, carrying a luminous organ divided into two symmetrical halves. *Scopelus* is another phosphorescent species, with a line of "eye-like, pearl-colored organs" running on each side of the fish from head to tail. Dr. Günther, in his "Introduction to the Study of Fishes," has given the possible uses of these organs as, first, to enable the fish to see; second, if placed on barbels and the like, to allure prey; third, to terrify foes. Of course, the luminous appearance departs at death.

If there were no Friction.—Having shown that friction is an insuperable impediment to the realization of perpetual motion, Prof. Hele Shaw observes that "if we are inclined to regret this fact, a little reflection on what would occur if friction ceased to act may not be uninstructive, for the whole face of nature would be at once changed, and much of the dry land, and, even more rapidly, most of our buildings, would disappear beneath the sea. Such inhabitants as remained a short time alive would not only be unable to provide themselves with fire or warmth, but would find their very clothes falling back to the original fiber from which they were made; and if not destroyed in one of many possible ways—such as by falling meteors, no longer dissipated by friction through the air, or by falling masses of water, no longer retarded by the atmosphere and descending as rain—would be unable to obtain food, from inability to move themselves by any ordinary method of locomotion, or, what would be equally serious, having once started into motion, from being unable to stop except when they came into collision with other unhappy beings or moving bodies. Before long they, with all heavier substances, would disappear forever beneath the waters which would now cover the face of a lifeless world."

British Whales.—The whales of the British Islands are more abundant and more varied in species than has generally been supposed. The most important of the species that have occurred in Great Britain is the Greenland right whale, which has now been driven into the far north. The Atlantic right whale was once hunted with considerable vigor in the English Channel; and those who hunted it there are said to have invented the harpoon, and taught the Dutch whalers how to use it. The hump-backed or Bermuda whale has been cast ashore on the islands, and is therefore entitled to be called a British species. A fourth species is the caaing or bottle-nose whale, a large school of which was seen in the summer of 1888 disporting in the Bay of Firth. The whale—an air-breathing mammal living in the water—is admirably adapted to its environment. The blow-holes are placed on the top of the head, and the animal can respire only when they are above the water. The animal heat is preserved and the specific gravity reduced by the thick coating of blubber that lies just under the skin. An interesting trait in the economy of the whale is the manner in which it suckles its young. It partly turns on its side, and the teats being protruded, sucking and breathing go on simultaneously. The "baleen" or whalebone of the "whalebone whales" consists of about five hundred laminæ—taking the place of teeth—ranged about two thirds of an inch apart, and having their interior edges covered with fringes of hair. Some of them are fifteen feet long. The cavity of a whale's mouth has been compared with that of an ordinary ship's cabin, the inside of which is covered with a thick fur. The soft, spongy tongue is often a monstrous mass ten feet broad and eighteen feet long. The whale feeds upon minute mollusks—*Medusæ* and *Entomostraceæ*—with which the northern seas abound. "Opening its huge mouth," says Prof. Huxley, "and allowing the sea-water, with its multitudinous tenants, to fill the oral cavity, the whale shuts the lower jaw upon the baleen-plates, and, straining out the water through them, swallows the prey stranded upon its vast tongue."

Standards of Light.—It is a delicate matter to obtain an accurate standard of light. Candles are still most relied upon for the tests of comparison, but it is obvious that they are susceptible of great variations in the intensity of the light they afford. Still, if made according to fixed rules, and their burning similarly regulated, they will give a fair approach to accuracy. Various English acts prescribe a sperm candle of six to the pound, and burning at the rate of one hundred and twenty grains per hour; also that the tip of the wick shall be glowing and slightly bent. Gas examiners are not always as particular in the matter as they ought to be, and, by allowing the wick to remain upright, may obtain a result indicating a gas of slightly more value than it really has. The German Gas and Water Society recommend an amyl acetate lamp, which is not quite as intense as a candle, and is objected to by Mr. W. J. Dibdin as being unsuitable in the color of its light. Dr. Werner Siemens has devised a selenium photometer, the electric resistance of which is exactly dependent on the light falling upon it. The pentane lamp, and the Methven screen, in which a coal-gas light is admitted through an aperture of fixed dimensions, are favored by many persons; and a standard afforded by a melting or a solidifying platinum wire is well spoken of.

John Mercer, F. R. S.—John Mercer has been called by Mr. T. E. Thorpe, in "Nature," the "Palissy of calico-printing." He achieved a great success in the arts without any other helps than those which he made for or attracted to himself. He was born, according to Mr. E. A. Parnell's "Life," in 1791, the son of a hand-loom weaver, who had turned to agriculture. When nine years old, he was set to work, on the death of his father, at bobbin-winding. A pattern-designer taught him reading and writing, and an excise-officer gave him lessons in arithmetic. He became interested in colors and dyeing, when sixteen years old, from observing the orange color of the dress of his little step-brother. Without books or means of obtaining instruction, but having got a full set of colors, and by the aid of trial experiments, he acquired considerable knowledge of the properties of dye-stuffs and of the current methods of coloring. Then he got books and learned exact methods. From this time his course was upward till he became master of his art, the inventor and teacher of new methods, and the author of some of the most valuable improvements that were made in dyeing previous to the introduction of the coal-tar colors. Mercer's skill and knowledge, says Mr. Thorpe, were ungrudgingly given to his fellow-workers in the art, and his assistance and advice were constantly sought. "He had, indeed, all the essential qualities and instincts of the scientific mind, and there was a certain comprehensiveness about the man, a certain vigorous grasp of general principles, and a largeness of view which made his influence felt at once among men of science." He was the author of some useful investigation in chemistry, and an early worker in photography.

A Chase of Evil Spirits.—A very curious custom is that called the women's hunt, which prevails among some of the aboriginal tribes of Chota Nagpore, India. It is observed whenever any calamity falls upon the community—such as, perhaps, a visitation of cholera. The women put on men's clothes, take up arms, and go a-hunting—not in the jungles, but in the nearest village east of them. They chase pigs and fowls, take as their own everything they kill, and levy black-mail from the heads of the villages for the purchase of liquor, or else they allow themselves to be bought off for a small sum of money and a pig. Toward evening the hunting party retire to a stream, cook and eat their meal, drink their liquor, and then return home, having acquitted themselves during the day in a thoroughly masculine and boisterous manner. Then the village that has been visited goes on a similar excursion to the next village east of it, and so on to the eastern borders of the district. By this series of excursions it is supposed the evil spirit of the affliction is safely conducted out of the district without offending its dignity. A single village is excepted from the operation of the custom, and is called Mahadaiva, being devoted to Mahadev, and under his special protection. If cholera appears there, it is because he is offended, and he must be propitiated before it will disappear.

A Discussion about Leprosy.—A recent discussion about leprosy in the Epidemiological Society of London has made it very obvious that our knowledge on the subject is extremely indefinite. While some persons insisted that the disease was fast increasing in India and is contagious and hereditary and threatening to European countries, others brought evidence of opposite tenor. A case was cited in which a man, born of leprous parents in a leper hospital and brought up there, who married a leprous woman, had not contracted the disease at thirty years of age. Other evidence was to the effect that contagiousness is conditioned by circumstances not well understood, among which are the quantity and character of the food supply. The influence of inheritance is as doubtful as that of contagion. On the other hand, it is certain that leprosy occurs in cases in which it has not been inherited, and no contagion can be traced.

Prunes.—Prunes are said to have been introduced into France by the Crusaders, and to have been first cultivated by the inmates of a convent near Clairac. The plum-tree is profitably cultivated in several of the departments, and grows well in any situation that is favorable to grapes. The fruit when ripe is covered with a "flower," which adds much to its value. It is usually gathered, after the night-damps have dried away, by shaking lightly from the tree, and only such as falls readily is taken. It is then put in a building, where it matures completely. Prunes are subjected to three or four cookings before they are ready for the market—two for the evaporation of the contained water, and the others for drying and giving a peculiar brilliancy to the product. In Provence the freshly gathered fruit is plunged into pots of boiling water, where it remains till the water again comes to the boiling-point. It is then shaken in baskets till cool, and dried in the sun on trays. At Digne the fruits are peeled with the nails and strung on sticks in such a way as not to touch, and then are stuck into straw frames and exposed to the sun till the prunes easily detach themselves from the stick. The pit is then removed, and the fruit is placed upon trays exposed to the sun. In some other districts the prunes are dried in immense ovens. The first cooking of the fruit should be at a temperature not exceeding 50°, the second 70° C., while the third may be performed at 80° or 90°, or occasionally 100° C. A well-cooked prune is dark purple, has a solid and brilliant surface, is malleable and elastic to the touch, with the kernel well done and intact in the shell. When these conditions are not fulfilled, the kernel ferments, and the prune becomes moldy and worthless. Bordeaux is the principal center of the prune industry, and has a trade that is increasing.

Climate and Phthisis.—The question, Does climate cure phthisis? is answered by Dr. James A. Lindsay, of Belfast, Ireland, in the affirmative, "beyond question." It does it, not usually by a single or specific quality of the air or by any definite combination of meteorological conditions, but by removing the consumptive from the evil influences of unfavorable meteorological conditions and of an injurious soil, and transferring him to a climate where fresh air, sunshine, and outdoor life may be enjoyed and their concomitant advantages realized. The best climates to cure phthisis are found at marine resorts and mountain resorts. The best marine resort is a sea-going ship—a sailing vessel preferred—and the longer the voyage the better. Next are ocean islands, coast islands, and shore places, of which Algiers, Tangier, and Malaga are among the best. Of the dry inland resorts, the best are Nubia, the interior parts of Algeria, the Orange Free State, and the vast interior plains of Australia—of which the Orange Free State is recommended on account of its altitude. The mountain resorts have proved most efficacious in cases of delayed recovery from pneumonia, with threatening tuberculosis, chronic pleurisy with much fibroid change, incipient catarrh of the apex, and chronic tubercular phthisis, with good reaction and the retention of fair constitutional vigor. They are not good for advanced and much weakened cases; and, speaking generally, only chronic cases with fair reaction are suitable for climatic treatment.

The Crofter's Question.—The English newspapers have had much to say concerning the agitations of the "crofters" of the Highlands and islands of Scotland. The crofters are small farmers, living on rental holdings which have generally been occupied by the family through many generations, or perhaps centuries, coming down from the times when the clan system prevailed. During the present century their holdings have been abridged by the development of sheep-farming in which the landlords have become interested, and more recently by the absorption of the land in immense deer parks. The crofters naturally object to being dispossessed of estates which they have come to regard as in a measure their inheritances, and have manifested their objections in ways common to rude and ignorant men. Deprived of their accustomed homes and of the only resources which they knew how to make available, their situation became so distressing and desperate as to awaken public attention and form a leading question in Parliament. They claim a right to security of tenure, to the fixation of rent by a land court, and to opportunities for enlarging their holdings. As defined in the "Westminster Review," their troubles are not the growth of a few years, nor are they due to any faults of their own, but rest upon claims of right far older than the present civilization and *régime* of the country. The historic claim of the crofters is, that the fertile lands in the Highland glens and pastures and on the hill-sides were the common property of the clan under the chief, and that, even though the chief may have been in the eye of the law the absolute owner of the land, still in point of fact and immemorial custom the clan shared his possessions, and had an undisputed and undisturbed right to their crofts and their pasures or grazings, on payment of a small rent, or on condition that they served under their chief in case of war. That this was the ancient custom is not questioned. The disregard of it now shown by the landlords, with the connivance of the authorities, is excused by saying that a security of tenure, founded in the old usage of the country, can not now be seriously entertained, as the clan system no longer exists, and the property has in many cases changed hands. At the same time, the Royal Commissioners appointed to inquire into the matter admit that the present crofters are the descendants and heirs of the holders who acquired these rights, and have done nothing to forfeit them. The landlords, however, have disregarded this tenure, have evicted the tenants, and have converted their farms into sheep-walks and immense deer ranges—enforcing their pretensions with many instances of cruelty and fiendish hardship; and Parliament has done nothing effectually to remedy the evil which has been allowed to grow up.

Italian Witch-Stories.—A practice, hybrid of the legitimate healing art and of the old witchcraft, is still current in parts of Italy. Its professors are fairly trustworthy respecting what comes under their own eyes, and prescribe judiciously for the ordinary ailments of animals, but can also tell some marvelous fables about minerals, plants, and beasts; and it sometimes requires discrimination to distinguish whether they are talking from knowledge or are repeating some old fancy. According to one of their stories, if one takes the eggs from a raven's nest, boils them, and puts them back, the parent bird will bring a stone of the same shape and size which will have the power of restoring life to them. The stone, remaining in the nest after the birds have flown, becomes half transparent and like an egg in everything except weight and hardness. When placed near poisoned food, the yolk will give warning of the fact by becoming violently disturbed. If a stone the size of a pea, which the lapwing is said always to deposit in its nest, is put under the pillow of a sleeping person, the sleeper will answer truthfully any reasonable question in the language in which it is asked. A particular serpent, reputed venomous at all times, is said to be especially so in May; and the first person it bites in that month will die himself, and also cause the death of any one who may stand beside him or come to his help. The fondness of snakes for milk gives the basis for the story of a coachman into whose open mouth a snake crawled while he was sleeping by the roadside. The doctors having failed to help him, he consulted the professors of the University of Naples; they hung him up by his feet and set a bowl of milk under his head. The snake was attracted by the smell of the milk, and crept partly out to get it, when it was pulled the rest of the way out. Of course, the coachman recovered.

Outdoor Tastes of the Australians.—The climate of Australia disposes to outdoor life; hence the most is made of holidays and of excuses for appointing them, and outdoor sports flourish as in no other country. Thought is quick, and speech nimble and marked by a reckless energy of diction—as when a young woman of great skill at lawn tennis is complimented by being described as "a terror." Mr. Ernest Moon finds a more serious result of the outdoor habit in the fact that there is little time or inclination left for reading. In very few homes, indeed, are there any indications of literary tastes. "Books or periodicals are conspicuous by their absence from most drawing-room tables. The periodicals at the club may remain for days uncut. Nor are the books at the club libraries numerous or in much request. . . . There are scientific institutions, and musical and art societies, but I have been assured on very good authority that there is no literary club or society of any kind. There are, of course, other reasons for the absence of literary life besides the allurements of the harbor, the garden, or the veranda. One of them is that there is not a class of literary people."

Classes of Men.—Recognizing the inequality among men, M. de Lapouge maintains that a man is what his birth made him, and that education can do no more for him than develop the pre-existing germs derived from his progenitors in accordance with the laws of heredity. This reasoning is extended to classes, nations, and races, who are assumed to be unequal and incapable of attaining to an equal degree of perfection. The author divides men into four classes, in the first of which he places those possessed of creative and initiative faculties above their fellows, while it is to the relative numerical preponderance of this class over the others that he refers the undoubted superiority of one race to another. He thus sees in the dolichocephalic blondes the most famed of all the races of humanity, since, from the dawn of history, all heroes and leaders among men have belonged to this type. In modern times the Anglo-Saxon race has owed its superiority to the preponderance of the dolichocephalic element. France is supposed to be suffering from the diminution of this type in its population, together with the rising preponderance of the brachycephalic type to which the lower classes of the community belong, while a great deterioration of the general personal character through the amalgamation of the two is anticipated as inevitable. Similarly the author sees in the present movement for raising the negro races a source of future danger to the Aryans, who may in time find themselves beaten down by the brute force of teeming masses of inferior brachycephalic peoples.

A Stoker's Life.—The stokers on one of the great ocean steamers work four hours at a stretch, in a temperature ranging from 120° to 160°. The quarters are close, and they must take care that while feeding one furnace their arms are not burned on the one behind them. Ventilation is furnished through a shaft reaching down to the middle of their quarters. Each stoker tends four furnaces, spending perhaps two or three minutes at each, then dashes to the air-pipe to take his turn at cooling off, and waits for another call to his furnaces. When the watch is over, the men go perspiring through long, cold passages to the forecastle, where they turn in for eight hours. One man, twenty-eight years old, who was interviewed by a reporter, had been employed at the furnaces since he was fourteen years old. He weighed a hundred and eighty pounds, and was ruddy and seemingly happy. He confessed that the work was terribly hard, but "it came hardest on those who did not follow it regularly. But if we get plenty to eat," he said, "and take care of ourselves, we are all right. Here's a mate of mine, nearly seventy years old, who has been a stoker all his life, and can do as good work as I can. Stokers never have the consumption, and rarely catch cold. Their grog had been knocked off on the English and American lines, because the men got drunk too often, and the grog did them much harm. When I used to take my grog, I'd work just like a lion while the effects lasted. I'd throw in my coal like a giant, and not mind the heat a bit; but when it worked off, as it did in a very few minutes, I was that weak that a child could upset me. Take a man dead drunk before the fires, and the heat would sober him off in half an hour, or give him a stroke of apoplexy."

Disparity in Marriage.—The "Westminster Review" shows that the widows greatly exceed the widowers in number, the proportion in England being as 1,410,684 to 589,644—a proportion which is not very greatly varied from through all the marriageable ages. The difference being hardly accounted for by the superior longevity of women, or the greater exposure to danger incurred by men, the "Review" finds a more efficient cause in marital disparity. Women prefer husbands who have made their fortunes and can give them ease and display, to young men who have their fortunes to make, with privations that must be shared. Thus taking companions considerably older than themselves, they naturally outlive them. It might be a more philosophical proceeding for the woman to marry a man younger than herself, that she may have his society through life, and a support when she will most need him. The results of this course to the cause of purity and to the health of the human race are to be deplored. Disparate unions have been shown to be fertile sources of the failure of marriage. A young woman marrying a man of like age is the right person in the right place. On the contrary, in marrying a man at the end of his manhood, she often drags him down. "Gross disparity was forbidden by Jewish lawgivers, and also by the most enlightened of pagan legislators. Is it wise or prudent to permit the vigor of manhood to be dissipated or wasted, and to allow posterity to owe its origin to the waning strength of old men? It is certainly contrary to the warning voice of the most intelligent and disinterested of the medical profession. . . . This widow-making vice of marital disparity is but one feature in that hymeneal profanation which is the curse and disgrace of our age, as it was of the decline of Rome."

Climates of British Health Resorts.—The isothermal lines in the British Islands run north and south rather than east and west. Hence latitude is there a less sure guide to temperature than longitude. All the health resorts on the east coast have a very similar character, although they differ so much in latitude; and the like rule holds good on the west coast. The resorts on the south coast differ materially, according as they lie toward the east or toward the west. As a general rule, the east coast resorts are dry, somewhat cold and bracing, while the west coast resorts are relatively humid, mild, and relaxing. All the coasts are more or less windy; but there is a great difference between the dry, somewhat parching, and decidedly bracing wind that comes to the eastern coasts across the German Ocean, and the soft, rain-laden breezes of the Atlantic. Some places, however, have a climate of their own, depending upon peculiar conditions. The line between the bracing and relaxing of the south coast resorts lies near the Isle of Wight. The most bracing resorts in England are those of Durham and Yorkshire; the most relaxing those of Devonshire and Cornwall. The resorts from the mouth of the Thames to Brighton form an intermediate class.

Distinctive Characteristics of Horse-flesh.—The inspector of slaughter-houses in Paris distinguishes between horse-flesh and beef by the following marks: Horse-flesh is reddish brown, becoming darker on exposure to the air; it has an odor peculiar to itself; it is soft and slightly tenacious, allowing the finger easily to sink into it, and the fibers, when worked, break up and become pulpy; the muscular fibers are long and fine, and united by very compact cellular tissue; in cooking, it hardens and becomes more dense and compact than beef; and under the microscope the fibers and striations of the muscular tissue are finer than in the flesh of the ox. These differences not always appearing sharply defined enough to make the distinction infallible, James Bell has sought other tests, and found them in the character of the fats. It was observed that the adipose tissue of the horse was of a softer and more oily nature than that of beef. On melting, horse fat, at 70° Fahr., formed a clear oil; the melting-point of beef fat, which is solid at ordinary temperatures, varied from 110° to 116° Fahr. At 100° Fahr. the specific gravity of horse fat ranged from 908·4 to 908·8; the specific gravity of beef fat, at 120° Fahr., was from 903·6 to 904. These important characteristics of difference, particularly the fluidity of horse fat at 70° Fahr., make the distinction between the two fats very plain.

Mental Powers of Spiders.—"Some Observations about the Mental Powers of Spiders" are recorded by G. W. and E. G. Peckham in the "Journal of Morphology." The authors experimented on hundreds of spiders of most of the common genera and species, with relation to such faculties as they may be supposed to possess, but found the way to knowledge on the subject "long and beset with difficulties." The faculty of smell seemed to be fairly developed in all but three out of twenty-six species. It was exhibited in different ways—by various movements of the legs, palpi, and abdomen, by shaking their webs, by running away, by seizing the rod conveying the perfume and binding it up as they would an insect, and by approaching the rod with the first legs and palpi held erect. The position of the organ of smell is unknown, and was not found. In hearing, spiders made no response to any loud or sensational sounds, but all the Epeirids were sensitive to the sound of the tuning-fork, while the spiders that do not make webs gave no heed to it. In love of offspring, all the spiders eagerly received back the cocoons when they had been deprived of them for various periods inside of twenty-four hours; some failed at twenty-four hours, while only a few recognized them after a longer period. They did not, however, seem able to distinguish their own cocoons from another spider's, or from a pith ball of the same size; and one of them even accepted a lead shot over which the covering of a cocoon had been stretched. In the sense of sight, they had great difficulty in finding their cocoons, even when removed from them only three quarters of an inch, and performed long and tortuous routes before they reached them; but in other matters they showed that they could see well enough. The trouble about the cocoons arose from the fact that the spiders never see them when carrying them, and therefore did not know them by sight, but depended on touch to identify them. The color sense appeared to be fairly well developed, with a very decided preference for red. The authors do not believe that spiders feign death. Epeirids drop and lie still for a time, but that is because, if they run about, they have difficulty in finding the thread that leads back to their web. Other spiders keep still, if at all, only for a few moments, but not long enough to give an appearance of death. Darwin's explanation is, therefore, correct, that the habit of lying motionless is the result of natural selection, and has been acquired by different species in different degrees, according to its usefulness in their various modes of life.

A Patriarchal Estate.—A patriarchal system of management is on trial on the estate of five thousand acres of Baron Raimondo Franchetti at Canedole, Mantua, Italy. Machinery and manures are liberally employed. Nobody pays any rent. The parish priest, schoolmaster, and doctor are employed and maintained by the proprietor. Sixty children are fed and looked after during the day in the Kindergarten, to and from which they are conveyed in an omnibus. The buildings are grouped, at the Corte de Canedole, around a square of fifteen thousand square yards area, with the master's house facing the entrance, and the steward's and other farm officers' dwellings, and the workshops, stables, barns, etc., near at hand. The whole is surrounded by deep canals flushed with running water, and flanked by avenues of plane-trees. Watchmen go their rounds at night. Work-hours are regulated by the sound of the bell; strict discipline is enforced; the upper hands set the example of steady and serious work, and grand balls are occasionally given by the baroness in the court-yard to all the peasants. It is not known how profitable the experiment has been, but it has not been a failure.

The Human Factor in Slums.—Mr. Frederick Greenwood, in a discussion in the "Nineteenth Century" of the problem of "Misery in Great Cities," maintains that the slums and squalid dens that abound in parts of London—and other enormous cities—"correspond far more than most kind souls are willing to perceive to the measure of depravity and weakness of the human mind; and at the same time to the proportion of incapables in a state of society which does not allow its incapables to perish." Every village and town has its bad spots and its centers of degraded population, corresponding in extent with its size; and it is only the vast extent of the mischief in London, commensurate with the dimensions of the city, and the appalling magnitude of the problems which it suggests, that excite so much commiseration and alarm. Hence it may be concluded that any local and spasmodic efforts to ameliorate the evils that exist are destined to only a very limited success, and that permanent advantage is likely to accrue only from measures that tend to raise the general social condition.

Inheritance of Acquired Habit.—In illustration of the hereditary transmission of characteristics acquired by habit, Prof. M. M. Hartog relates in "Nature" the case of a person who is unequally myopic in his eyes, and very astigmatic in the left one. On account of the bad images given by this eye for near objects, he was compelled in childhood to mask it, and acquired the habit when writing of leaning his head on the left arm, so as to blind it, or of resting the left temple and eye on the hand, with the elbow on the table. After putting on spectacles, when fifteen years old, he lost the habit of leaning. His two children, while they have not inherited the congenital defect, being emmetropic in both eyes, have received his acquired habit, and have to be watched to keep them from hiding the left eye when writing. A somewhat similar case of inheritance of acquired habit is related by J.

Jenner Weir of a goat and its kids in the Zoölogical Gardens. A chain was attached to the animal's neck to keep him from jumping over the fence. He became accustomed to take the chain up by his horns and move it from one side to another over his back; in doing this he threw his head very much back, so as to place his horns in a line with his back. His offspring have inherited this habit, though it has not been necessary to put chains upon them.

NOTES.

According to Mr. F. F. Payne's paper in the Canadian Institute, the Eskimos of Hudson Strait have a right to be called keen observers of nature. The author found them of great assistance while he was making his collections of birds, insects, and plants. "If an insect was shown them," he says, "they could usually take me where more of the same species might be found. On the approach of summer, they watched with more interest its signs, and often would bring to me insects which they believed were the first of the season."

The use of borax for the preservation of milk, which has become quite common when the milk has to be carried for a considerable distance, has suggested the question whether we may not have in this a means of promoting immunity against scarlet fever. Recent investigations have shown that this disease is often carried by milk, and in all probability frequently starts from cows. It has been remarked by Prof. W. Mattieu Williams that in all the cases where an outbreak of scarlet fever has been traced to milk, the dairy has been a local one—that is, a dairy that has supplied milk to families in its own immediate neighborhood, or so near as to render the use of borax unnecessary.

Fish-meat according to Prof. Atwater's researches, does not contain more phosphorus than ordinary butcher's meat. The benefit which brain-workers are said to derive from a diet of fish should therefore be ascribed, not to the phosphorus, but to the greater digestibility of the fish. The excess of phosphorus in the urine of such persons need not be regarded as a resultant of brain-work, but as an indication of the disordered digestion to which sedentary persons are liable. The recent researches of Zuelzer and others seem to indicate that excessive elimination of phosphorus by the urine is associated with nervous depression rather than with nerve activity.

Several instances of apparent counting are mentioned by Sir John Lubbock, in his "Senses of Animals," as exhibited by insects. The several species of *Eumenes*, for instance, supply their young with definite numbers of victims; and, while the males are smaller than the females, and require less food, the insect seems to know whether the egg will produce a male or a female grub, and apportions the quantity of food accordingly, giving five victims to the male and ten to the female. It is suggested by Mr. G. A. Freeman that the matter is one of physiological interval. The male eggs follow one another in less time than the female, giving time to store a smaller number of caterpillars before the next egg has to be provided for.

Powdered milk is prepared by reducing fresh milk, after having removed a portion of the cream, in a vacuum-pan, to the consistency of ordinary condensed milk. Granulated white sugar is next added, to render the mass sufficiently friable, and the temperature is lowered some twenty or thirty degrees. The contents are then removed from the vacuum-pan, and distributed in lumps, or reduced to a powder. It is claimed that powdered milk possesses excellent keeping qualities, even in moist air at high temperatures.

Dr. B. W. Richardson sounds the praises of a vegetarian diet when he assumes, in his lecture on "Ideal Foods," that what is commonly called happiness — lightness of heart, rapidity of thought, and all else that springs from a happy life—is connected with what we take as food. That happiness is best sustained by those foods which minister quickest and with least trouble to the digestion, and therefore to the wants of the body. Sir James Hannen had been struck, when he changed from animal food to a nearly vegetarian system, by the state of happiness that he experienced, compared with what he had felt before. The speaker had also felt this in his own life, and most when he was most nearly a vegetarian.

Although it was written in French and translated from that language into English, Prof. Guyot's "Earth and Man" has only recently been published in French for the first time.

The security of the Davy safety lamp has been partly improved, while a remedy has been found for the obscurity produced by the use of Marsant's safety bonnet, by the application of Mr. Andrew Howat's "deflector." The leading feature of this device lies in a flanged ring which is to be fitted tightly between the outer metal shield or bonnet and the gauze cylinder, by means of which all the air admitted for combustion is carried under or near the bottom of the bonnet and passed through the gauze into the burner part of the lamp. A brilliant light is thus obtained. This lamp has been passed through some severe trials, and has always been extinguished at once when exposed in a current of explosive mixture.

Mr. Thomas Ward assigns the causes of subsidences which have taken place at Northwich and its neighborhood, Cheshire, England, to the pumping of brine for the manufacture of salt. The first subsidence was noticed about 1770. The sinking has since gone on very rapidly, and much destruction of property has resulted. Large lakes or "flashes," one of more than one hundred acres in area, and of all depths down to forty-five feet, have been and are being formed.

In Central Africa, according to Dr. Junker, an almost perpetual state of warfare prevails. The abduction of a woman is often sufficient to engender strife; and, consequently, the abodes of the Central African tribes and their political conditions are subject to continual and incessant changes. If a conquered tribe will not surrender its territory, it falls into a condition of bondage to the victorious race. It can not be said that one district is wholly occupied by one race, but the population is in every case very mixed and composed of the most diverse elements.

The Akkas are described by Dr. Junker as the only voluntary nomads of the Central African regions. They construct their little cone-shaped grass huts in the shelter of the trees of the woods, and live in a district as long as the chase lasts. They prefer to abide among some tribes and avoid others. The rulers welcome them, and they, being practiced archers and cunning warriors, are employed in the invasions of the territories of neighboring tribes. They possess no industry, and buy even their arrow-heads in exchange for meat, the produce of the chase. They are timid and suspicious, and Dr. Junker only once saw about one hundred and fifty of them together. They can not properly be described as dwarfs, but only as relatively very small men.

M. Jean Luvini supposes that the electrical manifestations of the atmosphere are produced by the friction of particles of water and ice, and such other substances as may be lifted to the upper regions and dispersed through several miles of thickness. The differences in the character of the manifestations are dependent upon differences in intensity. Auroral lights are due to discharges in rarefied air.

A sailing vessel of new construction has undergone a successful trial at Southampton, England. Its peculiar feature is the shape of the submerged part, which is that of a W, with the angles well rounded off. The two keels are of brass, and hollow, so that the water flows through them from end to end. The vessel possesses remarkable buoyancy.

The Medico-Chirurgical Society of Edinburgh, discussing recently the subject of further legislation for habitual drunkards, were agreed that past legislation in the matter had been a complete failure. The present law presupposes the consent of the patient to measures for putting alcohol out of his reach for a year; the proposed new law, which the society approved, will do away with this condition. Sir D. Maclagan regarded the so-called "liberty of the subject" in such a matter as this as "an intense humbug." Dr. Batty Tuke insisted on a distinction between those whose drunkenness was a pure vice and those with whom it was an insanity; to which Dr. Yellowlees objected that it was hard to "house respectable lunatics with the class of habitual drunkards."

In a paper on "Clothing," Mr. Francis Vacher insists, as a primary consideration, on the importance of wearing clean, porous, and warm woolen clothing; condemns aniline and other injurious dyes; exposes the evils of scanty clothing, unequal pressure, heavy superfluous ornaments, ill-adjusted corsets, and high-heeled boots; discriminates between different styles of children's clothing; and pronounces the morning suit and under-wear of men nearly perfect.

As the conditions are set forth in Mr. J. B. Bailey's work on "Modern Methuselahs," moderation in eating, drinking, and living are conducive to long life. Persons in a comfortable position and of average intelligence enjoy better prospects for a long future than those at either extreme. "Earnest and ungrudging exercise of the mental powers appears to be no bar to old age, and at times to favor it; but, as a rule, while a moderate use of the faculties tends to health and endurance, excessive use of them has often, directly or indirectly, had a reverse effect."

For the removal of tattoo-marks from the skin, M. Variot recommends, in the "Revue Scientifique," covering with concentrated solution of tannin and retattooing in the part to be cleared; then rub with a nitrate-of-silver crayon, when the parts will turn black; sprinkle tannin-powder on the surface several times a day. A dark crust will form, which loses color in three or four days, and in a fortnight or so comes away, leaving a reddish scar free of tattoo-marks, which in a few months becomes little noticeable.

The question whether the cuckoo ever hatches its own eggs is still a subject of active discussion. Herr Adolf Müller has lately described a case which he himself claims to have observed. Herr Adolf Walter, who has not observed a case, thinks Dr. Müller is mistaken. An incident related by Dr. Erasmus Darwin is cited in evidence for the affirmative; but, as Dr. Darwin and his authority are beyond the reach of cross-examination, the adherents of the negative refuse to receive it.

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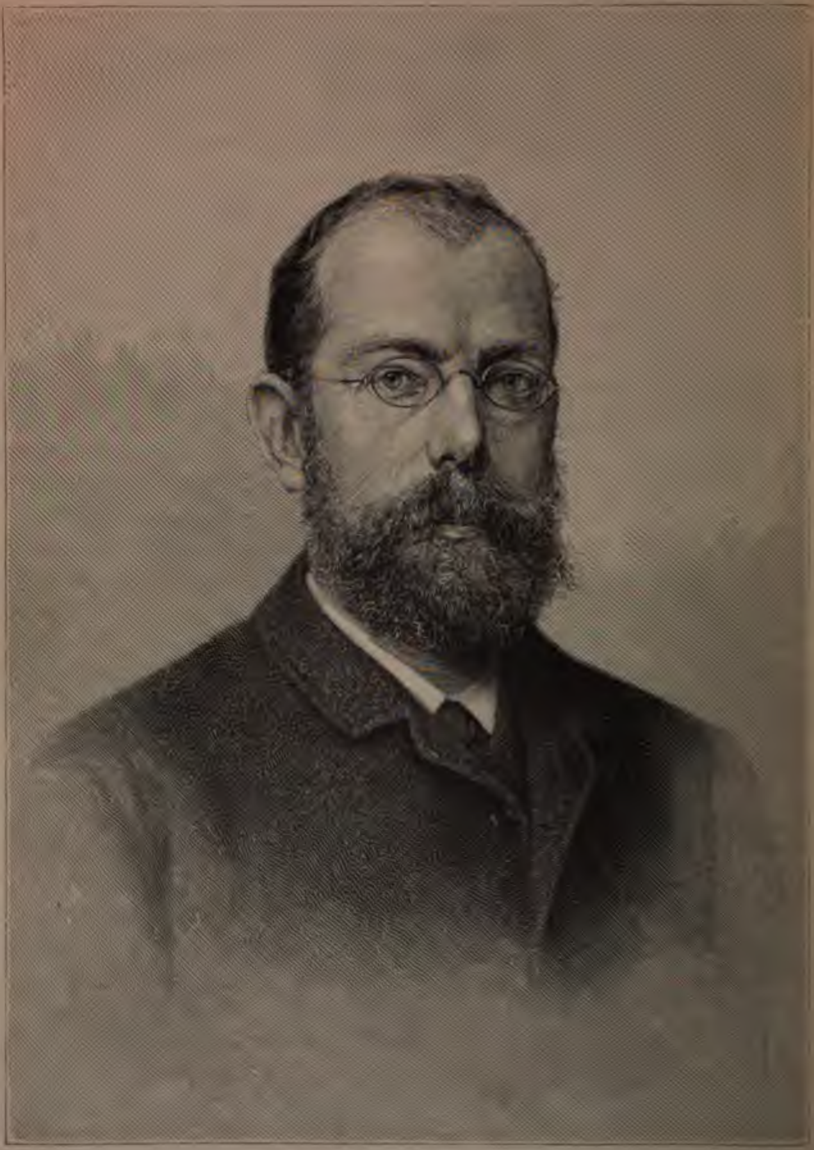

ROBERT KOCH.

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THE DESCENDANTS OF PALÆOLITHIC MAN IN AMERICA.

By Dr. CHARLES C. ABBOTT.

THE modest, peaceful valley of the Delaware River, from the head of tide-water southward, is as little suggestive of the Arctic Circle, for at least nine months of the year, as do its low and weedy banks in summer suggest the tropics. On the contrary, every tree, shrub, sedge, beast, bird, or fish that you see above, about, or within it is a feature of a strictly temperate climate. Nevertheless, a dim recollection of more stirring times still clings to it, and the year not unfrequently opens with the river firmly ice-bound. Over its shallows are often piled great masses of up-river ice, borne hither after a storm by the swollen current. Often the broad and shallow channel is effectually closed, and the river becomes, for the time being, a frozen lake.

But the ice, of late centuries, has not been able to hold its own for any significant length of time. The increasing warmth of the sun, and the south winds with their accompanying rains, soon start the little icebergs oceanward, or melt them when they are securely stranded. Except a few scattered masses along the shady shores, the river, by April, is a quiet, shallow, tide-water stream again.

No appreciable amount of detritus is now brought from the up-river region by a single winter's accumulation of ice. As the river and its shores are to-day, so they were a century ago—perhaps for many; but the winter of our varying year is a mere puppet-show compared with what New Jersey winters once were, and the culmination of arctic rigors gave our Delaware Valley, in that distant day, a far different aspect; and, with each succeeding glacial flood, more and more sand, gravel, and great bowlders were rolled down from the rock-ribbed valley beyond and spread upon the open plain through which the present stream unruffled flows.

The land was somewhat depressed then, and the water flowed at a higher level, but nothing unfavorable to man's existence obtained in the whole region. As a skilled geologist has pointed out, "The northern ice was one hundred miles away, and did not prevent primitive man from assembling about the low and hospitable shores of the miniature sea, . . . and over the bosom of the bay, little affected by tide because of its distance from the ocean, and little disturbed by waves because of its shoalness, palæolithic man may have floated on the simplest craft, or even have waded in the shallow waters." Ay! may have; but did he? What evidence is there that that most primitive of mankind, who left such abundant traces of his presence in the valley of many a European river, and also in Asia and Africa, was ever likewise here in eastern North America? It is precisely the same evidence—rude stone implements of the simplest type, often but slightly modified cobbles merely, that were found to be more effective by having a chipped and jagged edge, rather than the smooth and tapering one that water-wearing produces. These same worked stones—in other countries always of flint, but in New Jersey of argillite, a slate-like stone that has been altered by heat, and possesses now a conchoidal fracture—these occur in the Delaware gravels; and the vivid pictures of glacial time, with primitive man a prominent feature thereof, that have been given by Wright, Wilson, Haynes, McGee, Upham, Cresson, Babbitt, and others, are doubtless familiar to all readers of recent scientific literature.

In associating man with ancient river valleys, we are too apt to think only of the stream, and ignore the surrounding country. Though largely so, palæolithic man was not strictly an amphibious creature; for instance, on each side of the ancient Delaware River extended wide reaches of upland forest, and here, too, the rude hunter of the time found game well worthy of his ingenuity to capture, and so powerful that all his wit stood him well in need to escape their equally determined efforts to capture him. While the seal and walrus disported in the river; while fish in countless thousands stemmed its floods; while geese and ducks in myriads rested upon the stream, so, too, in the forest roamed the moose, the elk, the reindeer, the bison, the extinct great beaver, and the mastodon, all of which, save the elk, had long since left for more northern climes when European man first sighted North America.

The association of man and the mastodon is somewhat startling to most people; but, as has been time and again conclusively shown, it is no unwarranted fancy. We are apt to consider the mastodon as a creature of so distant a time in the unrecorded past, that man must necessarily have appeared much later upon the scene. The truth is, comparatively speaking, the creature so recently became extinct that, in all probability, our historic Indians were acquainted with it. Certain it is that, in the distant long ago of the great Ice age, the mastodon existed, and equally certain that with him lived that primitive man who fabricated the rude implements we have described. The bones of the animal and the bones and weapons of the man lie side by side, deep down in the gravels deposited by the floods from the melting ice-sheet. In February, 1885, I walked to and fro over the frozen Delaware, where it reaches a full mile in width, and saw at the time many horses and sleighs passing from shore to shore. I recalled, as I walked, what the geologists have recorded of the river's history, and it was no wild whim of the unchecked imagination to picture the Delaware as a still more firmly frozen stream; so firmly ice-bound, indeed, that the mastodon might pass in safety over it—not cautiously, even, but with the quick trot of the angry elephant—and picture still further a terror-stricken Stone-age hunter fleeing for his life.

Just as our brief yearly winter gives way to milder spring, so, as the centuries rolled by, the mighty winter of the Ice age yielded to changes that were slowly wrought. Century by century, the sun's power was exerted with more telling effect; constantly increasing areas of northward-lying land were laid bare, and the forest followed the retreating glaciers' steps. This great but gradual change had, of course, its influence upon animal life, and many of the large mammals that have been named appear to have preferred the cooler to the warmer climate and followed the ice-sheet on its northward march.

In the unnumbered centuries during which these changes came about, man increased in wisdom, if not in stature, and the rude implements that characterize the lowest known form of humanity —palæolithic man of prehistoric archæology — were gradually discarded for smaller and more specialized ones. This change was doubtless the result of faunal changes that required a compound instead of a simple implement, as an effective weapon—a small spear-head attached to a shaft, instead of a sharpened stone held in the hand; and we find now, as characteristic of conditions geologically later than the gravel beds, a well-designed spear-point, larger than Indian arrow-heads, of a remarkably uniform pattern, and which might readily be supposed to be the handiwork of the historic Indians. But let us examine into the history of these objects a little closely. In the first place, the conditions under which these rude spear-points are found, as a rule, are very significant. In certain upland fields, never far from water-courses, and which were the high, dry, habitable localities when the later gravel areas were yet comparatively low and swampy, these objects are found in great abundance, and very often not associated with the familiar forms of Indian implements. Again, they also occur in the alluvial mud which has been for centuries, and is still, accumulating over the tide-water meadows that skirt the banks of the Delaware River from Trenton to the sea. Now, it may be maintained that we are without warrant in assuming that the age or object of any given form of stone implement can be determined by the character of the locality where it happens usually to be found—exception, of course, being made to the palæolithic implements of an earlier geological period. To a certain extent this is true. A bead is none the less an ornament, whether dredged from the river-bottom or found in an upland field; and yet how very seldom does any implement or other relic of the Indians occur, except where we should expect to find them! In basing any conclusions upon the characteristic features of a locality where implements are found, it is necessary to determine if there has been any recent general disturbance of the spot. This is readily done usually, and the principal barrier to a logical conclusion is removed. Long experience in archæological field-work has fully convinced me that, in the vast majority of instances, stone implements are practically in the same position that they were when buried, lost, or discarded. A single specimen or even a hundred might mislead; but it becomes safe to base a conclusion upon the locality, when we have the material in such abundance as in this instance of these rude spear-points, and find that fully eighty per cent are from the alluvial mud of the river meadows, or such isolated upland areas as have been described. But more significant than all else is the fact that these simply designed spear-points are all of argillite, the same material of which are made the rude implements found in the gravel. There is, therefore, no break, as it were, in the sequence of events in the occupation of the region by man—no change of race, no evidence of an abrupt transition from one method of tool-making to that of another, but merely an improvement that was doubtless as gradual as the change from the epoch of glacial cold to that of our moderate climate of to-day. What at first sight appears fatal to the views here expressed is that a people so far advanced as to make these spear-points should have made many other forms of stone implements; but only the former are found deeply buried in the mud of the river. If, as is believed, the spears were used in fishing more than for any other purpose, they alone would be likely to be lost. Other objects in use upon their village sites would seldom, if ever, be taken to the fishing-grounds; and, as a matter of fact, there are found numbers of stone objects of a rude character, usually considered of Indian origin, but which are identical with those used, for instance, by the boreal Chukches. In Nordenskiöld's "Voyage of the Vega" is described a series of stone hammers and a stone anvil which are in use to-day for crushing bones. Every considerable collection of "Indian relics" gathered along our seaboard, from Maine to Maryland, contains examples of identical objects. Of course, the Indians might have used—indeed, did use—such hammers and anvils, but, considering all the evidence, and not merely a part of it, it does not follow that all hammers and anvils are of Indian origin. I have only made incidental mention of the historic Indian, and nothing further is necessary. He plays an important part in our early history, but his origin is yet to be deciphered from many sources. His arrival in the river's valley dates, as we reckon years, long, long ago; but no evidence is as yet forthcoming that it was prior to the valley's practically present physical aspect.

Let us consider these rude argillite spear-points, and the circumstances under which they occur, a little more closely. In this magazine (January, 1883), I based the opinion that these objects were of an earlier and other than Indian origin, because of their occurrence in so many localities at a depth greater than that at which jasper and quartz arrow-heads are found. In other words, the plow unearths the Indian relics in great quantities; but, by digging deeper, objects of argillite are found in significant numbers. In this earlier communication to the magazine, reference was made only to scattered objects; but now I propose to call attention to strictly surface-found specimens, where they have been discovered in such abundance as to plainly indicate the former sites of camps or villages. If such localities are really pre-Indian in origin, then it remains but to consider the fate of this earlier people; but, before indulging in speculation, what of the facts? The results of my labors may be summed up in a brief account of a visit to one locality; for all subsequent and preceding visits to distant points resulted similarly.

In two instances, collections which I studied were of such magnitude, and had been brought together with such care, that they had a decided bearing upon the question. The particular fields from which the great bulk of the specimens had been taken were studied most carefully, and it soon became evident, in each case, that the reported commingling of all forms of stone implements was more apparent than real. The physical geography of each locality plainly showed that for a very protracted period these spots had been habitable and inhabited. It was evident, in each case, that a very undulating surface had existed, through which meandered a small stream that had long since disappeared. These areas of hillock and dale had been densely wooded, with here and there a little clearing; and now, for nearly two centuries, plowed over almost every year. What, then, should we expect, presuming that the relics of two peoples had been left upon a tract of some two hundred acres? First, the tract was deforested, which would lead to much disturbance of the surface soil; secondly, the stumps of the trees were uprooted, which would lead to a greater disturbance; and, lastly, constant plowing, exposure of a raw surface to winds and rain, and the erosion due to the flooding of the stream that drained the tract, would result inevitably in the moving of objects, as small as arrow-points, to considerable distances from where they were left in Indian or pre-Indian times. It would be strange indeed if any evidence of earlier and later occupancy had withstood such vicissitudes; and yet such was the case. The highest ground afforded ninety per cent of the specimens I was able to find, of argillite; while in the low-lying area of the one-time stream's tortuous bed the argillite and jasper implements were commingled, with a preponderance of jasper and quartz in the ratio of seven to two. It was evident that the washing down of the higher ground and partial obliteration of the valley had transported the argillite and mingled it with the jasper, and not generally commingled and brought to certain points the equally scattered objects made of these minerals. During the summer of 1887 a very careful and intelligent observer reported to me that, in a field not far from where I live, he had found a considerable deposit of argillite chips, rude arrow-heads, and bits of pottery; but that there was no trace of jasper or quartz, or indeed of any other mineral. As I had collected Indian relics by the hundreds, in this same field, I refrained from visiting the spot, but requested my friend to examine the locality again with great care, and report to Prof. Putnam, of the Peabody Museum at Cambridge, Massachusetts. What was the result? My friend reported, briefly, that the spot was one uncovered by heavy rains, and formed part of the bank of a brook that crossed the field (this brook, I would state, was a considerable creek in 1680); that the argillite chips, rude arrow-points, knives, scrapers, and bits of pottery were found at a common level, and about fifteen inches below the present surface of the field. Prof. Putnam, in acknowledging the receipt of the specimens and report as to their discovery, replied that the pottery was of unusual interest, as it was exceedingly rude and differed very greatly from any that Dr. Abbott had sent from the same general neighborhood. As the bits of pottery from this general neighborhood that I have collected amount to hundreds of thousands, it would seem that Prof. Putnam's remarks have a good deal of significance.

As having a most important bearing upon this general question, it is well to refer to the results of others' labors in the same general field. In an address before the American Association for the Advancement of Science, at its Cleveland (Ohio) meeting, August, 1888, I referred to the Lockwood collection, now at the Peabody Museum at Cambridge, Mass. This series of ancient stone implements is one of exceeding value, because the objects are nearly all from shell-heaps on the coast of New Jersey. When arranging this collection, I was much impressed with the fact that the argillite implements, of which there were many considerable lots, were all labeled by Prof. Lockwood as having been found alone—i. e., not associated with similar objects of jasper or quartz; and again, that with the argillite was much very rude pottery, that bore little resemblance to the fragments of earthenware found in other places associated with the jasper, quartz, and chert implements. Subsequently, Prof. Lockwood informed me that, while these various finds did not vary in depth, they were very marked otherwise, and he did not recall any special "find" where the commingling of the two forms indicated that they had been in use at the same time.

Taking a hint from little brooks and the surrounding fields, let us consider, in conclusion, the more pretentious rivers and their surrounding uplands. Will the same results be obtained? Can we venture to reach out from the particular to the general? These were the questions that I frequently asked of myself, and, after many a weary tramp and toilsome digging over a wide area, I am happy to state that I believe my efforts have been crowned with a full measure of success. What held good in a particular field holds good of a county, and what I now claim for the tide-water portion of the valley of the Delaware I believe is true of a much more extended area.

In no case have I been able to find stone implements significantly distributed over a considerable space—i. e., tracts of five hundred to a thousand acres—except where there was, or very recently had been, running water. The ground, then, to be examined was either the high land that shut in the valley, or the valley itself, limiting that term to the banks of the stream and the immediately adjacent meadow tracts; exception being made where the bank of the stream was and always had been very precipitous. In such a case the brow of the bluff would be equivalent to the meadow or low land of a gently sloping valley.

In every such instance—and I have made or have had made many careful examinations of river and creek valleys—the result was the same: a very marked preponderance of argillite implements on the crests of the uplands, and a very great excess of jasper and quartz on the bottom land, or that directly adjacent to the stream. From this condition I am led to infer that, when these higher points were occupied, the present streams maintained a uniform flow as high as the freshet stage of these water-courses; and the fact that an Indian village site near by will be much nearer the river or creek shows clearly, I hold, that on a small scale the same conditions were repeated that occurred in the gradual change from glacial to post-glacial times. The volume of water in all our streams, comparing century with century, is gradually lessening.

Comparing then the rude objects of argillite, specialized as they are, with the magnificent flint-work of the historic Indians, I would designate the former as *fossil implements*, the latter as *relics*.

To this point I feel that I have been handling facts only, and deducing from them only logical inferences; but now looms up the natural and ever-interesting question, Who were these people? The origin of any race is a difficult problem to solve, but none can compare with these misty vestiges of prehistoric humanity. It seems to me but one inference is permissible: they who fashioned these rude argillite implements were the descendants of palæolithic man, and his superior in so far as a knowledge of the bow and arrow and rude pottery indicates. Beyond this, perhaps, we can not safely venture. Prof. Haynes has recently observed, "The palæolithic man of the river gravels at Trenton and his argillite-using posterity the writer believes to be completely extinct." While this at present seems to be the generally accepted conclusion, there is a phase of the subject that merits consideration. May not this "argillite-using" man have been a blood-relation of existing Eskimos? To accept the view of Prof. Haynes that "argillite" man became extinct infers an interval of indefinite length, when man did not exist on our central Atlantic seaboard; but if we may judge from the abundant traces of man that have been left and of the relation as to position that these three general forms, palæolithic, later argillite, and Indian, bear to each other, it would appear that, in the valley of the Delaware, at least, man has not for a day ceased to occupy the land since the first of his kind stood upon the shores of that beautiful river.

By referring these intermediate people to the existing Eskimos, I would not be understood as maintaining that these boreal people were directly descended from the argillite-using folk of the Delaware Valley, but that both were derived from palæolithic man; in other words, that with the disappearance of glacial conditions in the Delaware valley, and the retirement northward of the continental ice-sheet, if such there were, the people of that distant day followed in its tracks, and lived the same life their ancestors had lived when northern New Jersey was as bleak as is Greenland to-day; but that not all of this strange people were so enamored of an arctic life, and that many remained and, with the gradual amelioration of the climate, their descendants changed in their habits so far as to meet the requirements of a temperate climate. This explanation, it seems to me, best accords with known facts.

It is fitting, after a long tramp in search of human relics or remains, still so abundantly scattered over and through the superficial soil, to halt, at the day's close, upon the river's bank, and rest upon one of the huge ice-transported bowlders that reach above the sod. From such a point I can mark the boundary of the latest phenomenon of the valley's geological history, and seem to see what time the walrus and the seal sported in the river's icy waters; what time the mastodon, the reindeer, and the bison tenanted the pine forests that clad the river's banks, and what time an almost primitive man, stealing through the primeval forests, surprised and captured these mighty beasts—what time, lingering by the blow-holes of the seal and walrus in the frozen river, surprised and killed these creatures with so simple a weapon as a sharply chipped fragment of flinty rock. And, as the centuries rolled by, and the river lessened in bulk, until it but little more than filled its present channel, there still remained along its shores the more cultured descendants of the primitive chipper of pebbles. As a savage, so like the modern Eskimo that he has been held to be the same, this pre-Indian people still wrought the argillite that their ancestors were forced to use for their palæolithic tools; and as these spear-points are being gathered from the alluvial deposits of the more modern river, I can recall to their accustomed haunts this long-gone people, who, ere they gave place to the fierce Algonkin, were the peaceful tenants of this river's valley. Then, as we gather the beautiful arrow-heads of jasper and quartz, and pick from superficial soils grooved axes, celts, chisels, curiously wrought pipes, strange ornaments, ceremonial objects, and fragments of pottery, literally without number, we marvel at the skill of those who wrought them, and faintly realize how long these comparatively recent comers must have dwelt in this same valley, to have accumulated such an endless store of these imperishable relics.

We rightly speak of the antiquity of the Indian, but, remote as is his arrival on the Atlantic coast, it is modern indeed, in comparison with the antiquity of man in the same region. We can think of it, and perhaps faintly realize it, as "time relative," but in no wise determine it as "time absolute."

Dr. Burdon Sanderson foresees another division in science. He observes, in a biological paper in the British Association, that morphology and physiology have now diverged so widely, as regards subject and method, that there seems to be danger of a complete separation of one from the other.

GLASS-MAKING.

BY C. HANFORD HENDERSON,
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III.—THE EVOLUTION OF A GLASS BOTTLE.

TO a little sand, a little alkali, and a little limestone, add considerable heat and a still greater amount of skill, might be taken as a brief recipe for the manufacture of a glass bottle.

But to know in just what proportions to mix these several ingredients, how to produce and manage the requisite heat, and particularly how to cultivate that most essential part of the whole process, the manual dexterity which gives value to these other factors, are matters less briefly disposed of. Their consideration has made the evolution of a glass bottle a history covering several thousand years. The importance of this modest process will appear, if one is not already persuaded of it, when one recalls for an instant the multitudinous uses to which bottles are now put. It is difficult to fancy the confusion which would result were so simple an article of commerce suddenly withdrawn from the world of fact, and society called upon to manage without its service. Great would be the consternation of a host of manufacturers, and loud the outcry of a larger host of consumers.

The earlier man, it is to be remembered, had his herds always with him, his spring of water near his tent-door. He knew no tonic save the air of the desert, and few other beverages than the wine which was stored in sacks of goat's skin. To him bottles and their contents were matters of little moment. It is true that, in the storage of the one liquid which he preserved in this way, he did have to be careful not to put new wine into old bottles, but the proverb was easily recalled, and its precaution not difficult to carry out. He contented himself with his sack of skin, and found, in the projection which had once been the leg or neck of the animal, a mouth to his bottle sufficiently convenient to serve his purpose.

It was from receptacles such as this that the tired heroes of the *Iliad* regaled themselves, and the aged Noah partook too generously.

Even now this primitive bottle is largely used for the transportation and storage of water by the people of western Asia, and the usage seems to possess enough inertia to carry it forward several centuries further. Invading Americans may find the bottle of skin still in vogue, when their restless westward-moving activity carries them across the Pacific.

The substitution of glass bottles was effected but slowly even among the more progressive of ancient peoples. In the use of glass, the idea of beauty and decoration long remained paramount to considerations of utility. It was an article of luxury rather than of necessity. Darwin observed with amazement that when the weather was warm and fair, the Fijians paraded their coats of furs and feathers with all the pomp and pride of the Parisian *beau-monde*, only to stand naked and shivering in times of storm. It seems to have been much the same thing among the ancients with respect to their glass bottles. It was ornament in place of use. They were quite willing to get along without them in the economy of every-day life, provided they could have a few rare vases and gold-mounted amphoræ in the early *salons* where Rameses gossiped about Egyptian politics, and Potiphar discoursed upon the mysteries of metempsychosis.

It must be confessed that, in the pursuit of this one idea, they were eminently successful. Their glass trinkets were beautiful, both in outline and in color, even if their bottles for real service were made of skin, and liable to rip and tear. The glass *bric-à-brac* of antiquity, its bottles and vases and jars, was not of large dimension, but it possessed a profusion of color which we have only of recent years been able to imitate.

With us moderns, however, life is much more complex, and the case is quite different. We are not insensible to ornamentation, but we are more keenly alive to comfort. In the absence of a king's taster, we are disposed to guard what we eat and drink. The majority agree with Charles Lamb, that poisoning is "a nasty death," and so we eschew the use of metals in contact with our foods, and much prefer glass. We want milk miles from where it is produced, and fruits and vegetables months after their harvest. We want medicines for health, balms for bruises, tonics for appetites, mineral waters for digestion, wines for strength, condensed products for our travel. We want to separate with acids and put together with glues. We want a host of other things which come in bottles. We even bottle our electricity—if so unscientific an expression may be applied to the storage-battery. There is, in fact, scarcely a single department of life, either social or industrial, where some product is not needed which must be kept or carried in some form of glass bottle or jar. The manufacture of so useful an article is thus brought into relation with all of our many-sided activity. It forms a distinct and very important branch of the glass industry.

In America, the process of bottle-making is nowhere carried on more extensively or more successfully than in the neighborhood of Philadelphia. Much of the sand of southern New Jersey is sufficiently pure to make an excellent bottle-glass. Its adaptability for this purpose seems to have been appreciated by the early colonists, for the oldest glass-works in this country are those established in 1775 at Glassboro. They are still in operation, and are at the present day the most extensive of American bottle-works, employing as they do some six hundred persons in the conduct of their operations. It is a significant fact, showing the force of modern progress, that after existing for more than a century, the capacity of the "plant" was increased over fifty per cent during a recent period of three years. It is one of several establishments which have grown up in that neighborhood, and which have been attracted by the same cause, the abundance of a fair quality of sand. There is, moreover, something highly gregarious about modern industries. It frequently happens that many other localities offer quite as favorable conditions as the one selected; but the simple presence of a successful industry seems to turn men's thoughts in that direction, and lead them to undertake similar enterprises rather than to attempt the dangerous experiment of importing a new manufacture. To this principle of gregariousness, as well as to the wide wastes of sand, must the community of glass-workers in southern New Jersey be attributed. Like apparently begets like.

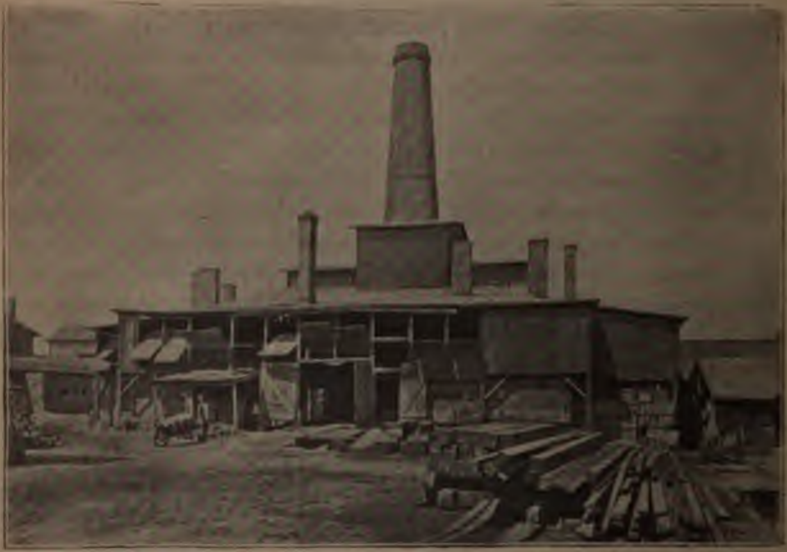

FIG. 1.—A GLASS-BOTTLE FACTORY IN SOUTHERN NEW JERSEY.

There is little that is attractive about the exterior of such a bottle-factory. One finds it set down in the midst of a flat, monotonous country, and surrounded by indifferent wooden houses with bare, sandy door-yards which bespeak small appreciation of the element of beauty. That these houses are homes, and are for the most part owned by those who live in them, adds immensely to their interest, but it does not conceal the fact that life here is material and ugly. It is not a beautiful or an inspiring thing to blow bottles all day long, unless one does it remarkably well; but the industry remaining, the life in these towns might still be made much less bare than it is, could that gospel of happiness and culture which Mr. Walter Besant and others are preaching in the East End of London find here some good apostle who would make it the burden of a new evangel.

In the larger bottle-works there are generally several melting furnaces, but each is complete in itself, a unit from which a larger or smaller plant may be constructed, according to the requirements of the case. Each furnace is lodged in its own building. A certain symmetry is loaned to these low, rectangular wooden structures by the tall brick furnace-shaft which rises through the center of the roof, and by the numerous smaller chimneys scattered around the edge. The sides of the building are movable on pivots, and when open give the factory somewhat the appearance of the Japanese houses pictured by Mr. Morse.

Inside of the factory all is life and movement. But, amid the dirt and confusion which characterize such an interior, there are the order of active money-getting and the beauty of a long-practiced dexterity.

If one follow the crude materials from the time they enter the building until they finally emerge in the form of many-shaped bottles, he will begin his inspection at the mixing-room, where the questions of content and proportion are decided. Large wooden wheelbarrows come and go, stopping long enough only to have their weight taken, and to dump their thoroughly ground contents into one of the bins on the side of the room. Patient old men, with hoe and shovel, mechanically mix together the stuff for the "batch." This varies in its composition according to the sort of bottles that are to be made. Three grades of bottle glass are recognized. The ordinary green glass is obtained from a mixture of about thirty-eight parts of soda and twenty parts of marble-dust to every hundred parts of sand. The glass is essentially a lime-soda glass, not dissimilar to window glass in its composition. The sand used comes from the neighborhood, and contains a little iron. As no bleaching agents are employed, this gives the glass its characteristic light green color—the bottle-green of our colorists. The second grade, the amber glass, has about the same composition, only it is colored by the addition of a little ground coke, black-lead, or some other form of carbon, about eight ounces to every hundred pounds of sand. This makes a much less innocent-looking bottle than the sea-green tint of the first glass. The finest grade, the so-called flint glass, contains about the same ingredients as the ordinary bottle glass, but the materials used are purer, and some such bleaching agent as manganese dioxide, arsenious acid, or nitrate of soda is used to make the glass colorless. Blue bottles are occasionally wanted, and in that case a little peroxide of cobalt is added to the customary batch to give the required color.

To obtain the best results, it is essential that the grinding and mixing of the crude materials be carefully looked after. At Glassboro the mixing as well as the grinding will soon be done by machinery in one central mixing-room, and the batch conveyed to the different furnaces by means of endless belts. It is believed that this improvement will insure a better product as well as more economical working.

The batch having been prepared, the next step in the development of the bottle is to change this dull-white powder into clear, fluid glass. Such a metamorphosis is accomplished in the melting furnace, which forms very naturally the central feature in a bottle-factory. The gratifying increase in the capacity of the Glassboro works is largely if not entirely due to the introduction of improved furnaces invented by the chemist of the works, Mr. Andrew Ferrari. They are continuous tank furnaces heated by gas—that is to say, the melting is carried out in large fire-clay tanks, and proceeds without interruption. There are other tank furnaces in use in America, but these are probably the only works where the melting is carried out continuously. Neither the employment of a tank in place of separate crucibles, nor the substitution of a gaseous for a solid fuel, is in itself new; but the details of the Ferrari furnace are quite novel. In Europe, the regenerative system of Siemens has been employed with marked success in the manufacture of glass; but, unfortunately, the Siemens furnaces are expensive in their construction and require some degree of skill to insure their best working. The Ferrari furnace, on the other hand, is an inexpensive affair and is easily worked. The gas generator is the usual inclined or "step" grate employed by Siemens, but it is placed directly alongside of the furnace, thus obviating the transportation of the gas, and the consequent necessity of reheating it before combustion.

At one end of the building one sees an elevated platform on which are stacked large blocks of bituminous coal. About six tons are daily required for each furnace. From this platform a line of low, irregular brick-work extends to the central stack. It contains the gas generators, three to each furnace, and beyond them the melting tank, which communicates on the other side with what is known as the working part of the furnace, lying directly under the central stack. The coal is fed directly into the generators from the platform, and on the inclined grate is completely burned—that is to say, it unites with all the oxygen possible, forming carbonic-acid gas. The supply of air may be regulated by dampers, so that the generator yields more or less gas according to the requirements of the furnace. But the carbonic-acid gas thus produced would be of no value as fuel, for it is totally incombustible. Rising, however, through the mass of incandescent fuel above it, the gas is speedily reduced to the condition of carbonic oxide, that combustible gas whose blue flame plays over the surface of an anthracite fire just after fresh fuel has been thrown on. This mixes with the volatile hydrocarbons—the coal-gas given off when fresh coal is introduced into the generator—and the mixture passes at once to the chamber above the melting tank. The air necessary for the burning of these generator gases is first heated by passing through a number of chambers in the lower part of the furnace. It is mixed with the gases to be burned just before they reach the fire-clay bridge separating the gas generator from the melting tank. The main combustion takes place right at this bridge, and produces an intense heat in the melting chamber, for both the gas to be burned and the air to burn it are highly heated before they are allowed to combine. The effect is the same as would be produced on a small scale if one fed his stove with the hot air from a register. This arrangement removes in a simple and inexpensive way one of the chief objections to the use of gas in glass-making. The fuel is so exceedingly convenient that its use in the industry was proposed, and indeed attempted, years ago, but a sufficiently intense heat could not be thus obtained.

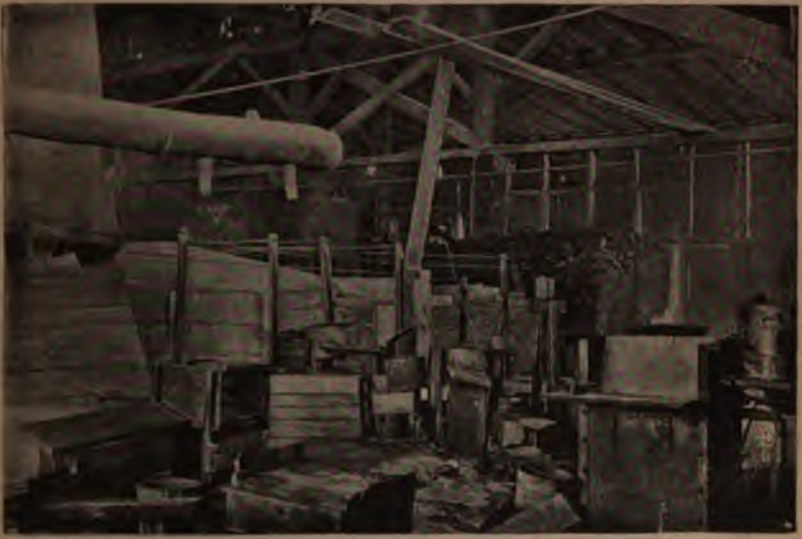

FIG. 2.—AN INTERIOR VIEW, SHOWING THE BRICK-WORK WHICH CONTAINS THE GAS GENERATORS AND MELTING TANK.

The furnaces are in continuous operation for ten months in the year. Every three hours during the entire twenty-four a charge of a ton and a half of the batch is added to the melting tank. In an atmosphere so intensely heated as this, it does not take very long for the crude materials to fuse and form a glass quite as liquid as water.

Picture for a moment the white-hot caldron in which this transformation of the opaque into the transparent takes place. It is an oblong tank, some eight by ten feet, in which the glass in various stages of fusion stands to a depth of nearly three feet. Above this seething mass there is a low arch which deflects the long, curling flame as it comes over the bridge from the generators, until it bathes the entire contents of the tank in its Plutonic breath. As the materials of the batch unite and melt—alone, they would be for the most part entirely infusible—the liquid glass sinks to the bottom of the tank and flows through small openings into the gathering chamber beyond. The glass resulting from the union of sand and alkaline bases is heavier than the crude materials from which it is formed, and consequently seeks the lowest level. In this way the tank, although filled with material in all stages of transformation, has always at the bottom a bath of thoroughly fused glass. The communication between tank and gathering chamber is arranged at such a level that the fluid glass alone can pass from one to the other.

This central gathering chamber and the busy life surrounding it are the points of chief interest to the visitor who wishes to see the scenic part of bottle-blowing, and is willing to take the chemistry and some of the more occult parts of the process on faith. The chamber itself is circular, usually about sixteen feet in diameter, and contains a bath of molten glass nearly two feet deep. The temperature of this fiery lake is kept above the fusing-point by the hot gases which come from the melting tank and rise into the high shaft immediately over the gathering compartment. It takes only from two and a half to three hours for the crude materials of the batch to pass to the condition of perfectly fused glass. This is pretty quick glass-making.

A little sand, a little alkali, a little limestone, and considerable heat have so far been expended, and the result is fluid glass. It is that greater amount of skill which is now needed to transform the glass into a bottle.

There is a series of openings, some sixteen in number, around the sides of the gathering chamber and a little above the level of the molten glass. Through these the glass-blower draws his supply, but he does not dip his blowpipe directly into this glowing reservoir. Such an arrangement would cause too great a loss of heat, besides interrupting the furnace-draught, and would be a source of constant annoyance to the gatherer on account of the impurities which float as a scum on the surface of the bath. To avoid these evils, each gathering hole has its "boot," a rounded hood of fire-clay which surrounds the hole on the inside of the chamber, and extends downward to the bottom of the bath in the shape of an oval cylinder. An opening near the bottom of the cylinder admits the fluid glass into the interior of the boot, and

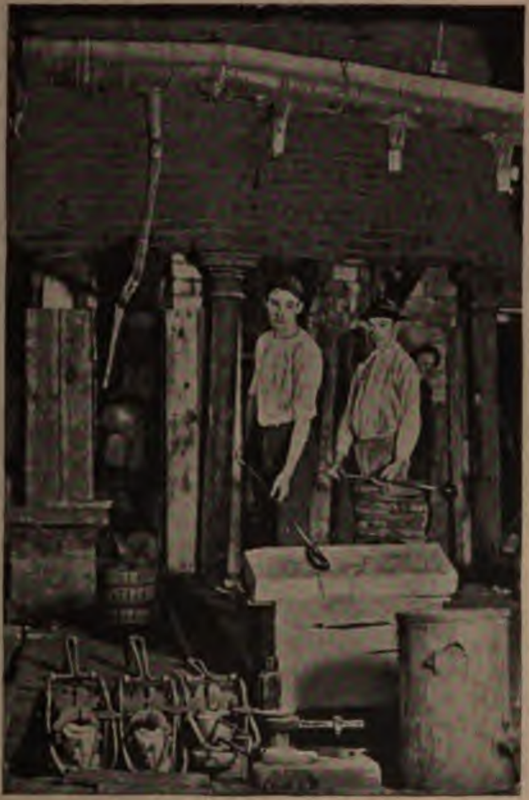

FIG. 3.—THE OPERATION OF "MARVERING."

permits it to stand always at the same level there as in the gathering chamber outside. Thus the gatherer draws his burden from this little bucket-like reservoir, but, like the widow's cruse of oil, the supply never gives out.

Outside of the furnace the agencies of heat and chemism are replaced by that of human dexterity. The men work in companies, which are known in the glass-maker's parlance as "shops." And very busy companies they are. They resemble nothing so much as a swarm of bees, as they hurry to and fro about the gathering holes. The condition is one of almost nervous activity. The men toss their blowpipes hither and thither in the operation of forming the bottles, and boys dart in and out of the crowd carrying bottles in all stages of development. There is complete singleness of purpose. They are all intent on turning out the largest number of bottles possible—for the pay is largely by the piece. Where the bottles are very small, one man has been known to blow as many as two hundred dozen in a day, but this is exceptional activity.

There are, all told, seven persons in such a shop: three men, of whom two blow the bottles, while a third, the gaffer, forms the necks, and four boys who gather the molten glass, open the molds, and carry away the finished products. The gatherer is a somewhat older boy than the others, and stands in direct line of promotion; is, in fact, a blower or gaffer in embryo. He aspires—the others but distantly. One shop is attached to each boot; and occasionally, when work presses, there are two shops to a boot, but this is rather crowding things and is not favorable to the best working. The process begins with the gatherer. His blowpipe is a tube of wrought iron, five or six feet long, and of lighter weight than the pipe used in blowing window glass. He dips the end of his pipe into the molten contents of the boot, and brings out a mass of red-hot plastic glass. If the bottles to be blown are small, one gathering suffices, but, for larger wares, two or even three gatherings may be necessary to get the requisite supply of material on the end of the blowpipe. When the gathering is done properly, this lump of red-hot glass is a perfectly homogeneous mass. Its subsequent fortunes rest with the blower. He takes the blowpipe from the gatherer, and, resting the plastic glass against a marvering table of stone or cast iron, he gives the pipe a few adroit rotations, thus fashioning the glass into an even cylindrical shape. By further rolling it along the edge of the table he forms the smaller prolongation of glass which is afterward to become the neck of the bottle. Lifting the still red-hot glass from the table, he blows through the pipe, forming a small bubble of air in the interior of the mass of glass. This is afterward extended until it becomes the inwardness of the bottle.

The partly fashioned bit of glassware is now introduced into the mold which one of the "shop" boys has already opened to receive it. For convenience in working, the mold is placed on a somewhat lower level than that on which the blower stands. It is made of cast iron, and is commonly formed in two pieces. One of these is stationary, while the other opens outward, its motion being controlled by a foot-lever. When the blower places his incomplete bottle, still attached to the blowpipe, into the mold, he closes the mold with his foot, and blows through the pipe until the plastic glass is everywhere forced against the sides of the mold, and has impressed upon it the form of its prison. Then with a quick motion the blower detaches his blowpipe from the projecting neck of the bottle—the glass is still plastic—hands it over to the gatherer, and with a fresh blowpipe repeats his labor. Such constant blowing largely develops the muscles of the cheek, but the exercise is not unwholesome. It is impossible by methods like these to obtain bottles of uniform thickness, yet the variations are much less than one would suppose.

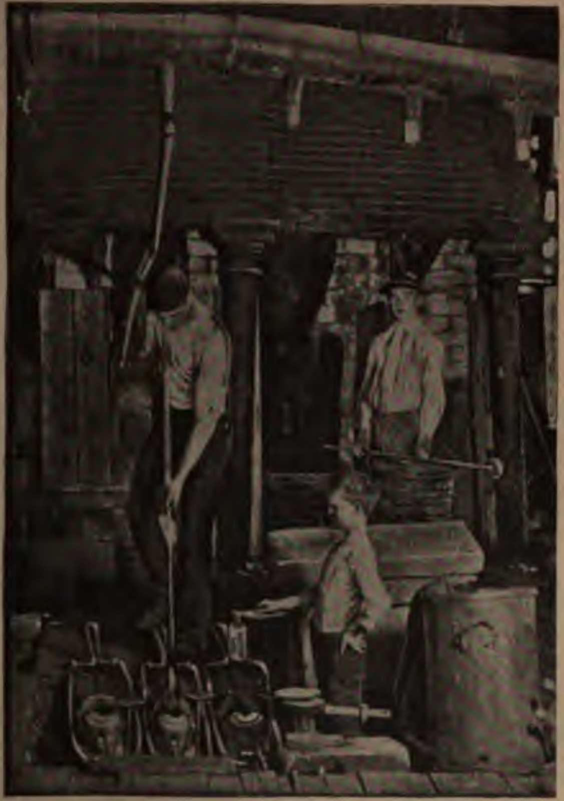

Fig. 4.—Putting the Bottle in the Mold preparatory to the Final Blowing.

In contact with the iron of the mold the bottle cools very rapidly. Almost as soon as the blower takes away his pipe, the mold may be opened and the bottle removed. The little fellow who does this is called a "snapper." He seizes the bottle with his iron forceps and transfers it from the mold to a pair of scales near by. A small square of asbestus cloth remains permanently on the scale-pan, as contact with the cold iron would be apt to crack the glass. All bottles, except the very small ones, are thus weighed, and any that show either a deficiency or an excess in weight are rejected. There will always be a slight variation, but it must be within narrow limits, not exceeding, for instance, an ounce in bottles intended to weigh seventeen ounces. Comparatively few bottles are rejected for this cause. The bottle of approved avoirdupois is placed in a closely fitting case of wrought iron mounted on a long handle. Only the neck of the bottle is allowed to project. Thus blanketed and mounted, the hot glass is easily handled.

It goes now to the gaffer, to have its neck properly shaped. He is found at no great distance, sitting before a little side furnace which affords three openings—"glory-holes"—large enough to admit the necks of the bottles, and a heated atmosphere of sufficient intensity to make the glass necks plastic and workable.

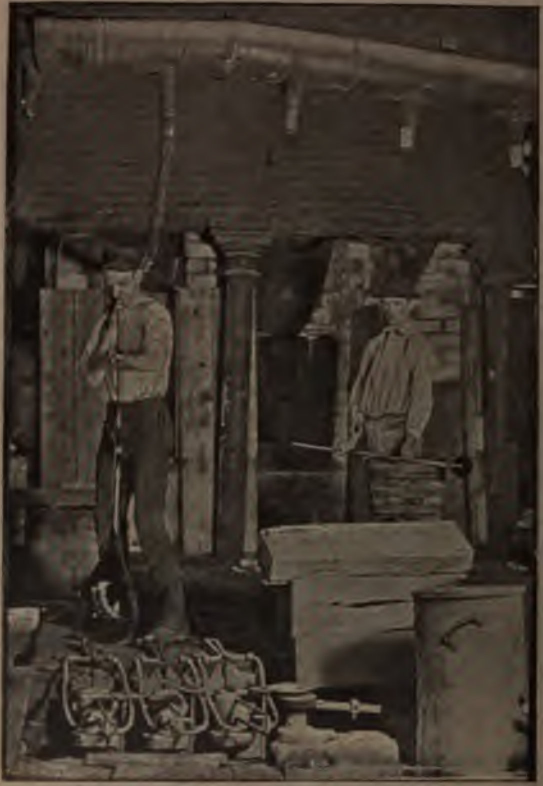

FIG. 5.—BLOWING A FLASK IN THE AIR.

Crude petroleum is the fuel used. It is stored in a tank to one side of the furnace, and trickles down, drop by drop, into a tube which brings a strong blast of air from a distant fan. In this way the oil is vaporized, and mixed with such proportions of air that the mixture is highly combustible, and in burning produces an intense heat. Three tongues of yellow flame thrust themselves out of the glory-holes and leap toward the gaffer sitting before them. In England this member of the shop is known as the chairman, a term which refers to his bodily rather than to his official position. He thrusts the necks of the incased bottles into the glory-holes, and then one by one withdraws them from their aureole and forms the necks. This he does by means of a convenient implement known under the generic name of tool. It consists of a central stopper, kept moist with oil, which is thrust into the mouth of the bottle, thus determining its gauge; and of two outside arms of iron, which, by the rotation of the case, the tool remaining stationary, form the smooth ring commonly adorning the necks of glass bottles. The gaffer, like the blower, is a quick workman, and does the finishing for both blowers belonging to his shop. He does not leave his chair, the glass being brought to him and carried away again by the little boys who have been noticed as darting about in such a lively fashion.

The bottle is now finished, so far as its form is concerned, but, like the window-pane under similar circumstances, it would have scant value if sent out into the world in its present condition. It would be too brittle, on account of its sudden cooling, and must therefore first be annealed. This operation is simply one of gradual cooling, and is carried out in ovens or in annealing leers.

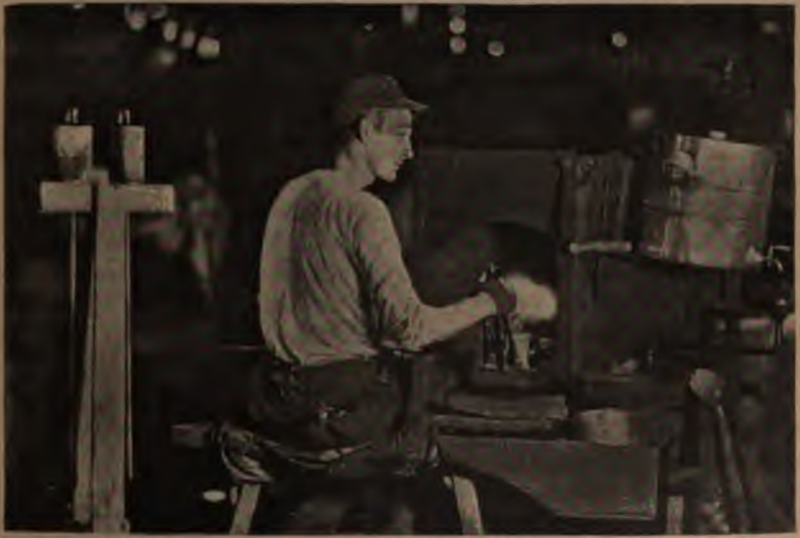

FIG. 6.—A VIEW OF THE GAFFER AT WORK, SHOWING HIS TOOL AND MANNER OF HOLDING THE BOTTLE WHEN FORMING ITS NECK.

The oven is a roomy chamber of brick-work, in which a wood fire is permitted to burn for a couple of hours in the early part of the day. It is opened when the blowers begin work, and during the remainder of the day it is gradually filled with bottles as the different gaffers finish them. At night it is closed and permitted to remain so for three days. At the end of that time the oven has become quite cold, and the bottles are thoroughly annealed.

The leer is a later invention and carries out the same process, only it acts continuously and is in so far an advance. It also consists of a roomy chamber of brick-work, but the fire is permanent and is located at one side of the chamber. A long brick passage-way extends for eighty feet from the back of this receiving chamber. The bottles are not piled directly on the floor, but are placed in low sheet-iron cars which move on a track extending the length of the passage-way. As soon as a car is filled, it is moved along the passage-way in order to make room for an empty car in the receiving chamber. In this gradual way the loaded cars are moved along the passage farther and farther from the source of heat, and finally discharge their loads at the cold end of the leer. It takes from forty-eight to sixty hours to accomplish the journey, though this is simply a matter of convenience, as the annealing process itself would not require more than from nine to ten hours, if so long as that.

Ordinarily the bottles, just as they come from the ovens and leers, are ready to be packed and shipped to their purchasers. In case, however, a seal has been blown in the side of the bottle and its prospective contents are of an effervescent character, the strength of each bottle must be carefully tested, as the glass forming the seal is apt to blow out thinner than the rest, and thus be a source of weakness. The testing is carried out by filling the bottle with water and then subjecting it to the pressure of a column of water equal to eighty pounds to the square inch. Only a few of the bottles, however, break under this ordeal.

But in case the bottle has a screw top, as in fruit-jars and the like, or is to have simply a plain ground edge, as in electric-battery jars, it is manufactured with a slight excess of glass on the top. This is known as a "blow-over." In this event the bottle does not pass through the hands of the gaffer, but goes directly from the blower to the ovens or annealing leers. In the grinding department the blow-over is knocked off and the rough edges ground smooth in a rotary grinding machine. In this the bottles or jars are put in upside down, eleven at a time, and have their edges pressed against the face of a large horizontal iron wheel which is rotated by steam-power. The framework in which the jars are held also rotates, and, in addition, each individual jar turns on its own axis. The iron wheel is supplied with a constant stream of sand and water, and this, with the triple motion of the machine, does very effective work. As many as sixty dozen jars can thus be ground in an hour.

The products of such a bottle-factory are as varied as the processes by which they are fabricated. There are large bottles and small bottles, tall bottles and short bottles, thick bottles and thin bottles, ugly bottles and pretty bottles—in fine, all sorts of bottles, according to the taste and requirements of the purchaser. He may order anything, from the tiny vial of one-drachm capacity up to the ungainly carboy holding fourteen gallons. He may have any tints desired, from the colorless flint glass through all shades of green and brown and blue to the bottle of absolute blackness. Or he may have any shape or form he pleases. Few if any bottles are kept in stock or made until ordered. Nearly all of the work is the direct filling of orders.

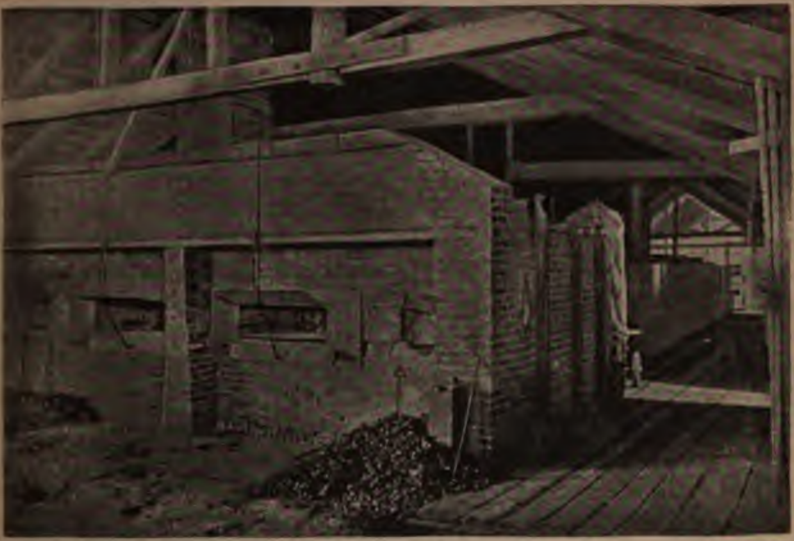

FIG. 7.—THE ANNEALING LEER, AS SEEN FROM THE FRONT.

It is only by comparison with the older order of things that one can appreciate the large improvements that have recently been introduced into the process of bottle-making. In the Glassboro works the Ferrari furnace has effected many changes and many economies. I am told, on very reliable authority, that not only is the quality of the glass much improved by the employment of these furnaces, but that in addition the experience of five years has shown their maintenance and operation to be notably less expensive than the old-style pot furnaces. In the matter of fuel the saving is said to have been more than fifty per cent. The repairs have also cost as much less in proportion. When the melting was done in pots, the cost of these alone made an appreciable item in the year's expenses. Each one cost about fifty dollars, and their average life was only two months. Occasionally one was known to last nine months, but for every such exception there were from two to three dozen which failed in less than a month. The four furnaces in operation would require in all about forty pots, and these renewed every two months would mean during the working year an expenditure for pots alone of ten thousand dollars. The present tank furnaces are out of blast during July and August, but the year's repairs are only a nominal expense. The hot season is chosen for renovation for very obvious reasons, though the heat alone is not sufficiently intense to make the cessation of work a necessity.

In thus following the evolutionary process by which a glass bottle is produced, one meets with many ingenious contrivances and many shrewd adaptations of means to ends, but he will scarcely meet with any problem of quite such deep interest as that presented by the people who carry out this process. Particularly is one struck with the large number of boys, scarcely more than children, who are employed in such a factory. About the furnace proper there are even more boys than men. The law does not permit the employment of children under twelve years of age, but exceptions are sometimes allowed by the labor inspector in case a boy has a widowed mother, or some other particular demand upon his early activity. New Jersey further attempts to protect her children by making an annual school attendance of five months compulsory for them. In the glass-blowing districts this requirement is met by the establishment of night schools supported by the State. The term lasts only for the allotted five months, the daily session being for two hours, from half-past six to half-past eight o'clock. My own limited observation of the working of night schools has led me to believe that they are but poor substitutes for work done earlier in the day when the boys are fresher and more buoyant; but the superintendent of a large factory, to whom I spoke on the subject, was of the opinion that these childish glass-workers are doing very satisfactory work in such schools. It is hard, nevertheless, that childhood should be made so short, and that the work-a-day life should begin so early for these little people. They seem, it is true, a very happy, merry set of youngsters, and, if one may judge from the tricks they are constantly playing on one another, they manage to get a fair share of boyish fun; but they can not fail to lose much in being so soon harnessed. As a class, these lads seemed to be finer looking and in many ways better conditioned than the older workers, so that one would naturally fancy that the hard work was leaving its landmarks. Men who have known them longer tell me, however, that it is a new generation, and one that has been reared under more favorable conditions of life.

They are comparatively well paid. The little boys make three dollars a week, and the larger ones six; modest sums admittedly; but large enough under the circumstances of country life to permit a little laying by. I felt curious to know what aspirations were most favored in such a community, and to what ideals the boys looked up. The story was soon told: to become glass-blowers, and to have plenty to eat—that was all; a life centered about bottles. Yet, among so many bright-faced lads, there are doubtless many of considerable promise, could their imaginations only be fired by some well-directed effort. Some one with a passion for culture and a big human heart could do great things, it seemed to me, with such quick, observant material.

With the older workers the dice have been cast, and life is well crystallized. It has left them divided into two classes: the green-glass blowers, who are chiefly Americans, and the flint-glass blowers, who are more largely Germans. Both bodies of men are closely organized, and as a result make excellent wages. The union to which they belong will not permit more than two apprentices a year to a single furnace. Such a regulation, with the annual increase of the industry and the inevitable deaths, practically excludes competition. The blowers make on an average five dollars a day. In rare cases as much as three hundred dollars a month has been paid to a single man. So large returns, however, are only possible for blowers and gaffers. The other members of the shop, as well as the numerous helpers employed in the conduct of such large enterprises, receive regular wages.

One other feature deserves mention. Throughout the entire works there is observable that marked tendency of modern industrial life to substitute continuous, automatic processes for those which are periodic and manual. The continuous annealing leer is taking the place of the oven; the steady flow of gaseous fuel is replacing the oft-repeated shovelful of coal; the continuous melting tank has been substituted for the discontinuous reservoir system represented by the crucible pots; the uninterrupted automatic charging of the furnace is about to do away with the manual feeding of the batch every three hours; and similarly, in all departments, the change is in progress. The operations of blowing have not yet been made automatic. Bottles but an inch long are still produced by the blower's breath, and little boys dispose of them one by one. But it is not improbable, in spite of the difficulties in the way, that a patent bottle-blowing machine will some day take the place of the army of workers who now swarm around the gathering chamber of a glass-furnace. Such a machine already exists in the brain of a man. When it is materialized into a working fact, the last step in perfecting the evolution of a glass bottle will have been taken, and any further development will be along lines already laid down.

PLAIN WORDS ON THE WOMAN QUESTION.

BY GRANT ALLEN.

IF any species or race desires a continued existence, then above all things it is necessary that that species or race should go on reproducing itself.

This, I am aware, is an obvious platitude; but I think it was John Stuart Mill who once said there were such things in the world as luminous platitudes. Some truths are so often taken for granted in silence, that we are in danger at times of quite losing sight of them. And as some good friends of mine have lately been accusing me of "barren paradoxes," I am anxious in this paper to avoid all appearance of paradox, barren or fertile, and to confine myself strictly to the merest truisms. Though the truisms, to be sure, are of a particular sort too much overlooked in controversy nowadays by a certain type of modern lady writers.

Let us look then briefly at the needful conditions under which alone the human race can go on reproducing itself.

If every woman married, and every woman had four children, population would remain just stationary. Or rather, if every marriageable adult man and woman in a given community were to marry, and if every marriage proved fertile, on the average, to the extent of four children, then, under favorable circumstances, that community, I take it, would just keep up its numbers, neither increasing nor decreasing from generation to generation. If less than all the adult men and women married, or if the marriages proved fertile on the average to a less degree than four children apiece, then that community would grow smaller and smaller. In order that the community may keep up to its normal level, therefore, either all adults must marry and produce to this extent, or else, fewer marrying, those few must have families exceeding on the average four children, in exact proportion to the rate of abstention. And if the community is to increase (which on Darwinian principles I believe to be a condition precedent of national health and vigor), then either all adults must marry and produce more than four children apiece, or else, fewer marrying, those few must produce as many more as will compensate for the abstention of the remainder and form a small surplus in each generation.

In Britain, at the present day, I believe I am right in deducing (after Mr. F. Galton) that an average of about six children per marriage (not per head of female inhabitants) is necessary in order to keep the population just stationary. And the actual number of children per marriage is a little in excess of even that high figure, thus providing for the regular increase from census to census and for overflow by emigration.

These facts, all platitudes as they are, look so startling at first sight that they will probably need for the unstatistical reader a little explanation and simplification.

Well, suppose, now, every man and every woman in a given community were to marry; and suppose they were in each case to produce two children, a boy and a girl; and suppose those children were in every case to attain maturity; why, then, the next generation would exactly reproduce the last, each father being represented by his son, and each mother by her daughter, *ad infinitum.* (I purposely omit, for simplicity's sake, the complicating factor of the length and succession of generations, which by good luck in the case of the human species practically cancels itself.) But, as a matter of fact, all the children do not attain maturity: on the contrary, nearly half of them die before reaching the age of manhood—in some conditions of life, indeed, and in some countries, more than half. Roughly speaking, therefore (for I don't wish to become a statistical bore), it may be said that in order that two children may attain maturity and be capable of marriage, even under the most favorable circumstances, four must be born. The other two must be provided to cover risks of infant or adolescent mortality, and to insure against infertility or incapacity for marriage in later life. They are wanted to make up the categories of soldiers, sailors, imbeciles, cripples, and incapables generally. So that even if every possible person married, and if every married pair had four children, we should only just keep up the number of our population from one age to another.

Now, I need hardly say that not every possible person does marry, and that we do actually a good deal more than keep up the number of our population. Therefore it will at once be clear that each actual marriage is fertile to considerably more than the extent of four children. That is, indeed, a heavy burden to lay upon women. One aim, at least, of social reformers should certainly be to lighten it as much as possible.

Nevertheless, I think, it will be abundantly apparent from these simple considerations that in every community, and to all time, the vast majority of the women must become wives and mothers, and must bear at least four children apiece. If some women shirk their natural duties, then a heavier task must be laid upon the remainder. But in any case almost all must become wives and mothers, and almost all must bear at least four or five children. In our existing state six are the very fewest that our country can do with.

Moreover, it is pretty clear that the best ordered community will be one where as large a proportion of the women as possible marry, and where the burden of maternity is thus most evenly shared between them.* Admitting that certain women may have good reasons for avoiding maternity on various grounds—unfitness, or, what is probably much the same thing at bottom, disinclination—and admitting also that where such good reasons exist, it is best those women should remain unmarried, we must still feel that in most cases marriage is in itself desirable, and that limited families are better than large ones. In other words, it is best for the community at large that most women should marry, and should have moderate families, rather than that fewer should marry and have unwieldily large ones; for if families are moderate there will be a greater reserve of health and strength left in the mothers for each birth, the production of children can be spread more slowly over a longer time, and the family resources will be less heavily taxed for their maintenance and education. Incidentally this will benefit both parents as well as the community. That is to say, where many marriages and small families are the rule, the children will on the average be born healthier, be better fed, and be launched more fairly on the world in the end. Where marriages are fewer and families large, the strain of maternity will be most constant and most heavily felt; the father will be harder worked, and the children will be born feebler, will be worse fed, and will start worse equipped in the battle of life.

Hence I would infer that the goal a wise community should keep in view is rather more marriages and fewer children per marriage, than fewer marriages and more children per marriage.

Or, to put these conclusions another way: in any case, the vast majority of women in any community must needs become wives and mothers; and in the best ordered community the largest possible number will doubtless become so, in order to distribute the burden equally, and to produce in the end the best results for the nation.

Well, it may be brutal and unmanly to admit these facts or to insist upon these facts, as we are often told it is by maiden ladies; but still, if we are to go on existing at all, we must look the facts fairly and squarely in the face, and must see how modern tendencies stand with regard to them.

Now, I have the greatest sympathy with the modern woman's demand for emancipation. I am an enthusiast on the Woman Question. Indeed, so far am I from wishing to keep her in subjection to man, that I should like to see her a great deal more emancipated than she herself as yet at all desires. Only, her emancipation must not be of a sort that interferes in any way with this prime natural necessity. To the end of all time, it is mathematically demonstrable that most women must become the mothers of at least four children, or else the race must cease to exist. Any supposed solution of the woman problem, therefore, which fails to look this fact straight in the face, is a false solution. It cries "Peace, peace!" where there is no peace. It substitutes a verbal juggle for a real way out of the difficulty. It withdraws the attention of thinking women from the true problem of their sex to fix it on side-issues of comparative unimportance.

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* Oh, yes, I know all about Malthus; but Mr. Galton has shown that a certain amount of over-population is necessary for survival of the fittest, and that if the best and most intelligent classes abstain, the worst and lowest will surely make up the leeway for them.

And this, I believe, is what almost all the Woman's Rights women are sedulously doing at the present day. They are pursuing a chimera, and neglecting to perceive the true aim of their sex. They are setting up a false and unattainable ideal, while they omit to realize the true and attainable one which alone is open to them.

For let us look again for a moment at what this all but universal necessity of maternity implies. Almost every woman must bear four or five children. In doing so she must on the average use up the ten or twelve best years of her life—the ten or twelve years that immediately succeed her attainment of complete womanhood. For note, by the way, that these women must also for the most part marry young: as Mr. Galton has shown, you can quietly and effectually wipe out a race by merely making its women all marry at twenty-eight: married beyond that age, they don't produce children enough to replenish the population. Again, during these ten or twelve years of child-bearing at the very least, the women can't conveniently earn their own livelihood; they must be provided for by the labor of the men—under existing circumstances (in favor of which I have no Philistine prejudice) by their own husbands. It is true that in the very lowest state of savagery special provision is seldom made by the men for the women even during the periods of pregnancy, childbirth, and infancy of the offspring. The women must live (as among the Hottentots) over the worst of these periods on their own stored-up stock of fat, like hibernating bears or desert camels. It is true also that among savage races generally the women have to work as hard as the men, though the men bear in most cases the larger share in providing actual food for the entire family. But in civilized communities—and the more so in proportion to their degree of civilization—the men do most of the hardest work, and in particular take upon themselves the duty of providing for the wives and children. The higher the type, the longer are the wives and children provided for. Analogy would lead one to suppose (with Comte) that in the highest communities the men would do all the work, and the women would be left entirely free to undertake the management and education of the children.

Seeing, then, that these necessities are laid by the very nature of our organization upon women, it would appear as though two duties were clearly imposed upon the women themselves, and upon all those men who sympathize in their welfare: First, to see that their training and education should fit them above everything else for this their main function in life; and, second, that in consideration of the special burden they have to bear in connection with reproduction, all the rest of life should be made as light and easy and free for them as possible. We ought frankly to recognize that most women must be wives and mothers; that most women should therefore be trained, physically, morally, socially, and mentally, in the way best fitting them to be wives and mothers; and that all such women have a right to the fullest and most generous support in carrying out their functions as wives and mothers.

And here it is that we seem to come in conflict for a moment with most of the modern Woman-Question agitators. I say for a moment only, for I am not going to admit, even for that brief space of time, that the doctrine I wish to set forth here is one whit less advanced, one whit less radical, or one whit less emancipatory than the doctrine laid down by the most emancipated women. On the contrary, I feel sure that while women are crying for emancipation they really want to be left in slavery; and that it is only a few exceptional men, here and there in the world, who wish to see them fully and wholly enfranchised. And those men are not the ones who take the lead in so-called Woman's Rights movements.

For what is the ideal that most of these modern women agitators set before them? Is it not clearly the ideal of an unsexed woman? Are they not always talking to us as though it were not the fact that most women must be wives and mothers? Do they not treat any reference to that fact as something ungenerous, ungentlemanly, and almost brutal? Do they not talk about our "casting their sex in their teeth"?—as though any man ever resented the imputation of manliness. Nay, have we not even, many times lately, heard those women who insist upon the essential womanliness of women described as "traitors to the cause of their sex"? Now, we men are (rightly) very jealous of our virility. We hold it a slight not to be borne that any one should impugn our essential manhood. And we do well to be angry; for virility is the key-note to all that is best and most forcible in the masculine character. Women ought equally to glory in their femininity. A woman ought to be ashamed to say she has no desire to become a wife and mother. Many such women there are, no doubt—it is to be feared, with our existing training, far too many; but, instead of boasting of their sexlessness as a matter of pride, they ought to keep it dark, and to be ashamed of it—as ashamed as a man in a like predicament would be of his impotence. They ought to feel they have fallen short of the healthy instincts of their kind, instead of posing as in some sense the cream of the universe, on the strength of what is really a functional aberration.

Unfortunately, however, just at the present moment, a considerable number of the ablest women have been misled into taking this unfeminine side, and becoming real "traitors to their sex" in so far as they endeavor to assimilate women to men in everything, and to put upon their shoulders, as a glory and privilege, the burden of their own support. Unfortunately, too, they have erected into an ideal what is really an unhappy necessity of the passing phase. They have set before them as an aim what ought to be regarded as a *pis-aller*. And the reasons why they have done so are abundantly evident to anybody who takes a wide and extended view of the present crisis—for a crisis it undoubtedly is—in the position of women.

In the first place, the movement for the higher education of women, in itself an excellent and most praiseworthy movement, has at first, almost of necessity, taken a wrong direction, which has entailed in the end much of the present uneasiness. Of course, nothing could well be worse than the so-called education of women forty or fifty years ago. Of course, nothing could be narrower than the view of their sex then prevalent, as eternally predestined to suckle fools and chronicle small beer. But when the need for some change was first felt, instead of reform taking a rational direction—instead of women being educated to suckle strong and intelligent children, and to order well a wholesome, beautiful, reasonable household—the mistake was made of educating them like men—giving a like training for totally unlike functions. The result was that many women became unsexed in the process, and many others acquired a distaste, an unnatural distaste, for the functions which Nature intended them to perform. At the present moment a great majority of the ablest women are wholly dissatisfied with their own position as women, and with the position imposed by the facts of the case upon women generally; and this as the direct result of their false education. They have no real plan to propose for the future of women as a sex; but in a vague and formless way they protest inarticulately against the whole feminine function in women, often even going the length of talking as though the world could get along permanently without wives and mothers.*

* A short time ago I received an angry letter from a correspondent in Iowa, full of curious bluster about "doing without the men altogether." Apparently this lady really imagined that the human race could be recruited from the gooseberry bushes.

In the second place, a certain real lack of men to marry, here and now, in certain classes of society, and those the classes that lead thought, has made an exceptional number of able women at present husbandless, and thus has added strength to the feeling that women must and ought to earn their own living. How small and local this cause is I shall hereafter try to show: but there can be no doubt that it has much to do with the present discontents among women. There is a feeling abroad that many women can't get married; and this feeling, bolstered up by erroneous statistics and misunderstood facts, has greatly induced women to erect into an ideal for all what is really a *pis-aller* for a small fraction of their body—self-support in competition with men.

But are there not seven hundred thousand more women than men in the United Kingdom? And must not these seven hundred thousand be enabled to earn their own living? That is the one solid fact which the "advanced" women are always flinging at our heads; and that is the one fallacious bit of statistics which seems at first sight to give some color of reasonableness to the arguments in favor of the defeminization of women.

As a matter of fact, the statistics are not true. There are not seven hundred thousand more women than men, but seven hundred thousand more *females* than *males* in the United Kingdom. The people who say "seven hundred thousand women," picture to themselves that vast body of marriageable girls, massed in a hollow square, and looking about them in vain, across wide leagues of country, for non-existent husbands. But figures are things that always require to be explained, and, above all, to be regarded in their true proportions to one another. These seven hundred thousand females include infants in arms, lunatics, sisters of charity, unfortunates, and ladies of eighty. A large part of the excess is due to the greater longevity of women; and the number comprises the great mass of widows, who have once in their lives possessed a husband of their own, and have outlived him, partly because they are, as a rule, younger, and partly by dint of their stronger constitutions. Moreover, this total disparity of seven hundred thousand, including babies, lunatics, and widows, is a disparity on a gross population of something more than thirty-five millions. Looking these figures straight in the face, we find the actual proportion of the sexes to be as 172 males to 179 females. Speaking very roughly, this makes about four females in every hundred, including babies, widows, and so forth, who have not a complementary male found for them. This in itself is surely no very terrible disproportion. It does not more than cover the relative number of women who are naturally debarred from marriage, or who under no circumstances would ever submit to be married. Out of every hundred women, roughly speaking, ninety-six have husbands provided for them by nature, and only four need go into a nunnery or take to teaching the higher mathematics. And if the marriageable men and women only are reckoned in the account, as far as I can gather from existing statistics, the disproportion sinks to a quite insignificant fraction.

Nevertheless, it is a fact, that both in England and America the marriageable men of the middle and upper classes are not to the fore, and that accordingly in these classes—the discussing, thinking, agitating classes—an undue proportion of women remains unmarried. The causes of this class disparity are not far to seek. In America the young man has gone West. In England he is in the army, in the navy, in the Indian Civil Service, in the Cape Mounted Rifles. He is sheep-farming in New Zealand, ranching in Colorado, growing tea in Assam, planting coffee in Ceylon; he is a cowboy in Montana, or a wheat-farmer in Manitoba, or a diamond-digger at Kimberley, or a merchant at Melbourne: in short, he is anywhere and everywhere except where he ought to be, making love to the pretty girls in England. For, being a man, I, of course, take it for granted that the first business of a girl is to be pretty.

Owing to these causes, it has unfortunately happened that a period of great upheaval in the female mind has coincided with a period when the number of unmarried women in the cultivated classes was abnormally large. The upheaval would undoubtedly have taken place in our time, even without the co-operation of this last exacerbating cause. The position of women was not a position which could bear the test of nineteenth-century scrutiny. Their education was inadequate; their social status was humiliating; their political power was *nil*; their practical and personal grievances were innumerable: above all, their relation to the family—to their husbands, their children, their friends, their property—was simply insupportable. A real Woman Question there was, and is, and must be. The pity of it is that the coincidence of its recognition with the dearth of marriageable men in the middle and upper classes has largely deflected the consequent movement into wrong and essentially impracticable channels.

For the result has been that, instead of subordinating the claims of the unmarried women to the claims of the wives and mothers, the movement has subordinated the claims of the wives and mothers to the claims of the unmarried women. Almost all the Woman's Rights women have constantly spoken, thought, and written as though it were possible and desirable for the mass of women to support themselves, and to remain unmarried for ever. The point of view they all tacitly take is the point of the self-supporting spinster. Now, the self-suppor is undoubtedly a fact—a deplorable accident of the passing moment. Probably, however, even the most rabid of the Woman's Rights people would admit, if hard pressed, that in the best-ordered community almost every woman should marry at twenty or thereabouts. We ought, of course, frankly to recognize the existence of the deplorable accident; we ought for the moment to make things as easy and smooth as possible for her; we ought to remove all professional barriers, to break down the absurd jealousies and prejudices of men, to give her fair play, and if possible a little more than fair play, in the struggle for existence. So much our very chivalry ought to make obligatory upon us. That we should try to handicap her heavily in the race for life is a shame to our manhood. But we ought at the same time fully to realize that she is an abnormity, not the woman of the future. We ought not to erect into an ideal what is in reality a painful necessity of the present transitional age. We ought always clearly to bear in mind—men and women alike—that to all time the vast majority of women must be wives and mothers; that on those women who become wives and mothers depends the future of the race; and that, if either class must be sacrificed to the other, it is the spinsters whose type perishes with them that should be sacrificed to the matrons who carry on the life and qualities of the species.

For this reason a scheme of female education ought to be mainly a scheme for the education of wives and mothers. And if women realized how noble and important a task it is that falls upon mothers, they would ask no other. If they realized how magnificent a nation might be molded by mothers who devoted themselves faithfully and earnestly to their great privilege, they would be proud to carry out the duties of their maternity. Instead of that, the scheme of female education now in vogue is a scheme for the production of literary women, schoolmistresses, hospital nurses, and lecturers on cookery. All these things are good in themselves, to be sure—I have not a word to say against them; but they are not of the center. They are side-lines off the main stream of feminine life, which must always consist of the maternal element. "But we can't know beforehand," say the advocates of the mannish training, "which women are going to be married, and which to be spinsters." Exactly so; and therefore you sacrifice the many to the few, the potential wives to the possible lady lecturers. You sacrifice the race to a handful of barren experimenters. What is thus true of the blind groping after female education is true throughout of almost all the Woman Movement. It gives precedence to the wrong element in who under. What is essential and eternal it neglects in favor Out of ever accidental and temporary. What is feminine in women it neglects in favor of what is masculine. It attempts to override the natural distinction of the sexes, and to make women men—in all but virility.

The exact opposite, I believe, is the true line of progress. We are of two sexes: and in healthy diversity of sex, pushed to its utmost, lies the greatest strength of all of us. Make your men virile: make your women womanly. Don't cramp their intelligence: don't compress their waists: don't try to turn them into dolls or dancing girls: but freely and equally develop their feminine idiosyncrasy, physical, moral, intellectual. Let them be healthy in body: let them be sound in mind: if possible (but here I know even the most advanced among them will object), try to preserve them from the tyranny of their own chosen goddess and model, Mrs. Grundy. In one word, emancipate woman (if woman will let you, which is more than doubtful), but leave her woman still, not a dulled and spiritless epicene automaton.

That last, it is to be feared, is the one existing practical result of the higher education of women, up to date. Both in England and America, the women of the cultivated classes are becoming unfit to be wives or mothers. Their sexuality (which lies at the basis of everything) is enfeebled or destroyed. In some cases they eschew marriage altogether—openly refuse and despise it, which surely shows a lamentable weakening of wholesome feminine instincts. In other cases, they marry, though obviously ill adapted to bear the strain of maternity; and in such instances they frequently break down with the birth of their first or second infant. This evil, of course, is destined by natural means to cure itself with time: the families in question will not be represented at all in the second generation, or will be represented only by feeble and futile descendants. In a hundred years, things will have righted themselves; but meanwhile there is a danger that many of the most cultivated and able families of the English-speaking race will have become extinct, through the prime error of supposing that an education which is good for men must necessarily also be good for women.

I said just now that many women at present eschew marriage, and that this shows a weakening of wholesome feminine instinct. Let me hasten to add, for fear of misconception—I mean, of course, if they eschew it for want of the physical impulse which ought to be as present in every healthy woman as in every healthy man. That independent-minded women should hesitate to accept the terms of marriage as they now and here exist, I do not wonder. But if they have it really at heart to alter those terms, to escape from slavery, to widen the basis of the contract between the sexes, to put the wife on a higher and safer footing, most sensible men, I feel sure, will heartily co-operate with them. As a rule, however, I observe in actual life that "advanced" women are chary of either putting forward or accepting modifications in this matter. They dread the frown of their Grundian deity. They usually content themselves with vague declamation and with erecting female celibacy into a panacea for the ills that woman is heir to, while they refuse to meddle at all in definite terms with the question of marriage or its substitute in the future. While denouncing loudly the supremacy of man, they seem ready to shake off that supremacy only for the celibate minority of their sex, without attempting to do anything for the married majority.

To sum up the point whither this long, and I confess discursive, argument is tending. There is, and ought to be, a genuine Woman Question and a genuine Woman Movement. But that movement, if it is ever to do any good, must not ignore—nay, on the contrary, must frankly and unreservedly accept and embrace—the fact that the vast majority of adult women are and will always be wives and mothers (and when I say "wives," I say so only in the broadest sense, subject to all possible expansions or modifications of the nature of wifehood). It must also recognize the other fact that in an ideal community the greatest possible number of women should be devoted to the duties of maternity, in order that the average family may be kept small, that is to say, healthy and educable. It must assume as its goal, not general celibacy and the independence of women, but general marriage and the ample support of women by the men of the community. While allowing that exceptional circumstances call for exceptional tenderness toward those women who are now compelled by untoward conditions to earn their own livelihood, it will avoid creating that accident into a positive goal, and it will endeavor to lessen the necessity for the existence of such exceptions in the future. In short, it will recognize maternity as the central function of the mass of women, and will do everything in its power to make that maternity as healthy, as noble, and as little burdensome as possible.

If the "advanced" women will meet us on this platform, I believe the majority of "advanced" men will gladly hold out to them the right hand of fellowship. As a body we are, I think, prepared to reconsider, and to reconsider fundamentally, without prejudice or preconception, the entire question of the relations between the sexes—which is a great deal more than the women are prepared to do. We are ready to make any modifications in those relations which will satisfy the woman's just aspiration for personal independence, for intellectual and moral development, for physical culture, for political activity, and for a voice in the arrangement of her own affairs, both domestic and national. As a matter of fact, few women will go as far in their desire to emancipate woman as many men will go. It was Ibsen, not Mrs. Ibsen, who wrote the "Doll's House." It was women, not men, who ostracized George Eliot. The slavishness begotten in women by the *régime* of man is what we have most to fight against, not the slave-driving instinct of the men—now happily becoming obsolete, or even changing into a sincere desire to do equal justice. But what we must absolutely insist upon is full and free recognition of the fact that, in spite of everything, the race and the nation must go on reproducing themselves. Whatever modifications we make must not interfere with that prime necessity. We will not aid or abet women as a sex in rebelling against maternity, or in quarreling with the constitution of the solar system. Whether we have wives or not—and that is a minor point about which I, for one, am supremely unprejudiced—we must at least have mothers. And it would be well, if possible, to bring up those mothers as strong, as wise, as free, as sane, as healthy, as earnest, and as efficient as we can make them. If this is barren paradox, I am content to be paradoxical; if this is rank Toryism, I am content for once to be reckoned among the Tories.—*Fortnightly Review.*

NEW PHASES IN THE CHINESE PROBLEM.

By WILLARD B. FARWELL.

THE whirligig of politics, rather than that of time, undoubtedly brought about the hasty passage by Congress of the so-called "Chinese Exclusion Act." Being simply "a supplement" to the act of May 6, 1882, which expires by its own limitation on the 6th of May, 1892, it can of course only be regarded as a temporary measure; and unless other legislation of like character, but more well considered and permanent in its operation, is had before May 6, 1892, the country will then be as open to the free and unrestricted immigration of the Chinese as it was prior to the treaty of 1881, and the act to execute its provisions to which this is a supplement. The passage of this measure by Congress, and its approval by the President, suggest new phases in the Chinese problem. First among them all is, Will exclusion exclude, as provided in the machinery of this act? To find an intelligent answer to this question, it is necessary first to understand the causes and motives which impel the Chinese to migrate from their native country. Until this phase of the question is fairly presented, the difficulties involved in excluding the Chinese by legislative methods will not be rightly estimated by Congress or by the country at large.

With an area of 1,297,999 square miles, China possessed a population in 1882, according to the best accepted authorities, of 380,000,000, or a fraction less than 300 people to the square mile. This average, large as it is, gives no adequate idea of the real density of the population in the nine important provinces of China. In 1812 the Chinese census gave 850, 705, and 671 inhabitants to the square mile in the three provinces of Kiangsu, Nganhwsu, and Chehkiang respectively. These averages have since increased largely, but there are no reliable data from which to give the present population per square mile in these or other provinces. The struggle for life under such conditions of overpopulation must necessarily be severe beyond description. But when we add to this the fluctuations of rainfall, involving frequently occurring periods of drought and flood, and consequent famine and misery, we begin to perceive the true causes of Chinese emigration.

The famine of 1878, growing out of the drought of the four preceding years, it is estimated, swept from nine and one half to thirteen millions of inhabitants out of existence. "At all epochs," says the Abbé Huc, "and in the most flourishing and best-governed countries, there always have been, and there always will be, poor; but unquestionably there can be found in no other country such a depth of disastrous poverty as in the Chinese Empire. Not a year passes in which a terrific number of persons do not perish of famine in some part of China, and the number of those who live merely from day to day is incalculable. Let a drought, an inundation, or any accident whatever occur to injure the harvest in a single province, and two thirds of the population are immediately reduced to a state of starvation. You see them forming themselves into numerous bands—perfect armies of beggars—and proceeding together, men, women, and children, to seek in the towns and villages for some little nourishment wherewith to sustain for a brief interval their miserable existence. Many fall down by the wayside and die before they can reach the place where they had hoped to find help. You see their bodies lying in the fields and at the road-side, and you pass without taking much notice of them, so familiar is the horrid spectacle."

"Calamities of this kind occur every year in some place or other; and those who have made any savings are able to get through the crisis and wait for better days; but others, who are always in much greater numbers, have no choice but to expatriate themselves or die of famine."

In 1855 Sir John Bowring, the "British Resident at Canton," in reply to inquiries from the Registrar-General in London, gave some interesting facts concerning the Chinese, which were subsequently published by the Statistical Society. Speaking of the emigration from China, he said:

"The constant flow of emigration from China, contrasted with the complete absence of immigration into China, is striking evidence of the redundancy of the population; for, though that emigration is almost wholly confined to two provinces, viz., Kwangtung and Fookien, representing together a population of probably from 34,000,000 to 35,000,000, I am disposed to think that a number nearer 3,000,000 than 2,000,000 from these provinces alone are located in foreign countries. In the kingdom of Siam it is estimated that there are at least 1,500,000 Chinese, of which 200,000 are in the capital (Bankok). They crowd all the islands of the Indian Archipelago. In Java, we know by correct census there are 136,000. Cochin-China teems with Chinese. In this colony we are seldom without one, two, or three vessels taking Chinese emigrants to California and other places. Multitudes go to Australia, to the Philippines, to the Sandwich Islands, to the western coast of Central and Southern America; some have made their way to British India. The emigration to the British West Indies has been considerable, to the Havanna greater still. The annual arrivals in Singapore are estimated at an average of 10,000, and 2,000 is the number that are said annually to return to China."

"There is not only this enormous maritime emigration, but a considerable inland efflux of Chinese toward Manchuria and Thibet; and it may be added that the large and fertile islands of Formosa and Hainan have been to a great extent won from the aborigines by successive inroads of Chinese settlers. Now these are all males; there is not a woman to 10,000 men; hence, perhaps, the small social value of the female infant. Yet the perpetual outflowing of people seems in no respect to diminish the number of those who are left behind."

Sir John Bowring not only testifies to this perpetual outflow of Chinese emigrants, but he paints in vivid colors the causes which lead to these results. He says: "There is probably no part of the world in which the harvests of mortality are more sweeping and destructive than in China, producing voids which require no ordinary appliances to fill up. Multitudes perish absolutely from want of the means of existence; inundations destroy towns and villages, and all their inhabitants; it would not be easy to calculate the loss of life by the typhoons and hurricanes which visit the coasts of China, in which boats and junks are sometimes sacrificed by hundreds and by thousands. The late civil wars in China must have led to the loss of millions of lives. The sacrifices of human beings by executions alone are frightful."

It is such a condition of things, and such causes as these, that induce the laboring classes of Chinese to emigrate to other countries. Considering the incentive which exists in these densely populated districts to escape from the misery which marks their existence, and to seek new lands where their condition may be bettered, the dangers that threaten from such inexhaustible sources of human supply become easy of appreciation.

It may well be inferred that a line of public policy on the part of any other nation intended to shut out such a class of immigration as this must be literally "iron-clad" in its construction, and must involve measures of defense practically as stern, unrelenting, and costly in their character as are the measures of defense against invasion commonly taken among nations at war with each other.

So far, Chinese immigration in other countries has been sufficiently powerful to break down all the barriers that have been reared against it. Wherever they have gained a foothold there they have continued to go, there they have increased and multiplied. Wherever they have gone, in earlier or later times, prolonged contact with them and competition in the field of labor have developed the same race antipathies that exist between the American people on the Pacific coast and the Chinese to-day.

Since 1860 200,000 Chinese have landed in Chili and Peru. Nearly 400,000 have found their way into the United States through the port of San Francisco since the Chinese immigration first began. The numbers that have migrated to Australia, the Sandwich Islands, and other countries have been enormous. The larger part of this emigration from China has occurred since the walls of Chinese exclusiveness were battered down by English and French cannon in 1858. It is clear that, while China was then opened to the commerce and intercourse of the world, so the world was likewise opened to the free flow of the yellow tide of Chinese immigration, sweeping with constantly augmented and resistless force in every direction. We have seen the incentive of poverty and misery at home that underlies and induces Chinese emigration. We have seen that with them it is either expatriation or starvation. We have seen that massacre and cruelty can not change their purpose or intimidate them, and we may well ask ourselves the question whether the mild type of legislation embodied in the "Scott Exclusion Act" can be more effective in this direction. Assuming that it will be sustained by the Supreme Court of the United States, assuming that it will effectually stop the landing of Chinese in our ports, how far will it prove effective in barring the entrance of Chinese along the thousands of miles of frontier that intervene between British Columbia on the north and Mexico on the south? Is it to be presumed that Chinese cunning and perseverance, inspired by their wretched condition at home, and the incentive of good wages, constant employment, and a more comfortable mode of life here, will not overcome all obstacles that this hasty and crude kind of legislation has set up against them? Is it to be presumed that a law that imposes upon them no penalty other than that of being sent back if they are detected, will keep them out, when the fear of death has been found wholly ineffective to do so? Will exclusion exclude under such conditions as these? Moreover, can any law ever be enacted by an American Congress that would not shock the Christian world by the inhumanity of its penalties, that will ever be effective in excluding them from our soil? For violations of State and municipal laws the jails and prisons have been crowded with Chinese for months and years, and all to no purpose. The constant perpetration of the same offenses manifests but too plainly the utter inutility of dealing with the Chinese by any such methods as these.

The race that is reared under the fear of the "cangue," the "bastinado," and limb and bodily torture of hideous ingenuity as punishments for trivial offenses, can not be restrained or terrorized by prison penalties as ordinarily provided under American laws. Much less can they be prevented from attempting to gain entrance into the country by the mere fear of being sent back if detected. And it may well be believed that thousands upon thousands would still continue the attempt, in willing exchange for free board and lodging in a well-kept American prison, with hard labor, were that penalty made to attach to the act.

Under such circumstances as these, will exclusion exclude, in the way and manner provided in the "Scott Exclusion Act"? More than this, can any remedy for Chinese immigration be devised that does not look to the stationing of an army of thousands of men along our northern and southern borders, and at a cost bordering upon the permanent prosecution of a defensive war, except by treaty co-operation on the part of the British provinces on the north and Mexico on the south?

The inefficiency of this hasty political measure of exclusion is only equaled by the public disgrace involved in the manner of its inception and enactment, which the most radical believer in the policy of Chinese exclusion can not fail to admit constitutes the most shameful page in American history.

If we are to assume that this or any other legislation that may be had by Congress *can* be made to result in effectual Chinese exclusion, the problems that present themselves for consideration are hardly less interesting and deserving of study than if this class of immigration were to be tolerated indefinitely. Already there are probably more than 200,000 Chinese upon American soil. In mode of life, costume, religion, clannishness, social vices, and language, they may be said to have evinced no perceptible change during the forty years that have elapsed since they found lodgment here. Had they, during all this period, remained in the heart of the Chinese Empire, they could not have been more intensely Chinese in all respects than they are to-day with all their experience of contact with American civilization. True, they have been the gainers to the extent of the knowledge and skill they have acquired in the field of skilled labor and the use of machinery, but it has made no impression upon their race-habits and instanced no sign of assimilation with the race which surrounds them.

We are accustomed to regard our own ethnological stock as the dominant race of mankind; and yet, wherever the Chinese have colonized among us, we have yielded the ground before their advancing hosts, and have surrendered to them a dominance in law, social habits, and religion. While all other races which combine to form the American people proper yield common obedience to the laws, and may be regarded as a common brotherhood in social and political citizenship, the Chinese have remained a law unto themselves, and in the estimation of the Christian communities in which they have established themselves they are the same unchanged and unchangeable heathen race that they were when they landed upon our shores. Such have been the results of nearly forty years of contact of the two races. If we consider this period too short a time in which to look for contrary results, what shall we say of the fact—for fact it is—that in the Philippine Islands, where the Chinese have been colonized now for nearly three hundred years, precisely the same results have come about—no better and no worse? Not only have they maintained their race characteristics, but in every instance they have proved themselves to be the stronger, in so far as the acquisition of material wealth and advantage are concerned, maintaining all the while their religion against all efforts at conversion.

"In 1871," says the Baron von Hübner, "the entire English trade with China, amounting to £42,000,000 sterling, was transacted through English firms." Since that time, he adds that, "with the exception of some great influential English firms, all the same trade has passed into the hands of Chinese merchants." In Macao similar results have obtained.

When the Manchus conquered China, they swept all before them and introduced Manchu habits and customs. But steadily these innovations gave way to Chinese influences. "You may now," says the Abbé Huc, "traverse Manchuria to the river Amoor without being at all aware that you are not traveling in a province of China. The local coloring has been totally effaced. The Manchu Tartars have almost totally abdicated their own manners, and adopted instead those of the Chinese."

Has Chinese colonization in San Francisco shown any different results? Let us see. That portion of San Francisco known today as Chinatown was originally the residence and business center of the town. Its natural advantages made it the choice of the early American settlers, and as such it would doubtless have remained to-day had it not been for the advent of the Chinese. These latter, seeing also its advantages, located themselves there. As they increased in numbers, Christian civilization with instinctive repugnance retreated before them, until, within this entire district, once literally San Francisco itself, there is not a vestige of American civilization remaining save in the abandoned homes, churches, and other private and public buildings, each one of which fairly swarms with hordes of unclean and unsavory Chinese. A missionary writer, the Rev. Mr. Gibson, an advocate of Chinese immigration for Christianizing purposes, tells the story in his book, "The Chinese in America," of the abandonment of the "First Baptist Church" in San Francisco to the Chinese:

"What was lately the First Baptist Church of San Francisco is now a crowded Chinese tenement-house, full of all manner of filthiness, shame, and sin. Where but lately was the altar of the living God, now smokes the incense of idolatry. That sacred temple, where once the voice of prayer and praise to God was heard. now echoes with idolatrous chants and bacchanalian songs. Instead of standing firm against the incoming hosts of idolatry and sin, the Church of Christ has beaten an ignominious retreat, has surrendered without a struggle one of the strongest fortifications and retreated in disorder before the advancing hosts of idolatry." Thus, here as elsewhere, they have established their supremacy, defied all laws for their government and the suppression of their vices, and erected themselves into an *imperium in imperio*, conquering and still to conquer.

If the further coming of this race be successfully prevented, it will probably be contended that, among the new generations which are to be born here, and which will be entitled to all the rights and privileges of American citizenship by reason of that fact, the influences of Christian civilization will be so powerful as to obliterate race habits and vices, and substitute those of our own race for their own. There has been no test of this under these special conditions, and therefore there can be nothing foretold with precision in regard to it. We can not lose sight of the fact, however, that the children born of Chinese parents in San Francisco so far are as distinctly Chinese in race, habits, superstitions, vices, and costume as were their fathers before them. Thus far there has not been a perceptible change in them. As in every other country where they have colonized the same results have followed, why should we look for different results here? It will be said that they are quick to learn, and capable of excelling in all classes of skilled labor, and therefore they should be equally responsive in exchanging their race habits and civilization for our own. However plausible such a theory may sound, forty years' experience in San Francisco testifies to the contrary. A people of traditions, the lives, work, and history of whose generations are and always have been but a repetition of each other, they seem incapable of change except in the acquisition of such mechanical skill and knowledge as can be made subservient to their material advantage.

The successful exclusion of further Chinese immigration, and thereby the complete isolation of the Chinese who are among us from their countrymen at home, will certainly offer a more favorable field for Christian missionary work than has heretofore existed. But that which has been accomplished thus far certainly does not inspire confidence that much is to be gained in that direction. Mr. Gibson, the most prominent of all missionary workers among the Chinese in California, testified in 1876 to the effect that, out of one hundred and fifty thousand Chinese in California, but two hundred and seventy-one had, up to that date, been baptized and received into Christian church communion. And he failed entirely to note how many of these had fallen from grace, and gone back to their original faith and practices. He failed also to give the simple truth to the world that, for every "soul so hopefully converted and saved"—to use his own words—thousands of young men had been ruined by the presence of the Chinese through the introduction and spread of the opium habit, the dissemination of hereditary disease through their innumerable dens of prostitution, the destructive influences of their lottery and gambling dens, and the general demoralization of the field of labor.

Is there not something that always has and always will successfully resist efforts at Christianization of the Chinese? Let us resort again to the testimony of that devout and earnest missionary, the Abbé Huc, than whom no one has ever written more clearly and truthfully of the habits and characteristics of the race:

"In the five ports open to Europeans, religious liberty really does exist, and it is protected by the presence of consuls and ships of war. Yet the number of Christians does not increase more rapidly than in the interior of the empire. In Macao, Hong-Kong, Manila, Singapore, Penang, Batavia, though they are under the dominion of Europeans, the great mass of the population consists of Chinese, who for the most part are permanently settled in these cities, and hold in their hands the great interests of agriculture, commerce, and industry. It is certainly not the fault of persecution of the European authorities that hinders them from embracing Christianity. Yet the conversions are not more numerous than elsewhere. . . .

"The Chinese are so completely absorbed in temporal interests, in the things that fall under their senses, that their whole life is only materialism put in action. . . .

"Lucre is the sole object on which their eyes are constantly fixed. . . . A burning thirst to realize some profit, great or small, absorbs their faculties, the whole energy of their being. They never pursue anything with ardor but riches and natural enjoyments. God, the soul, a future life, they believe in none of them, or rather they never think about them at all."*

The Chinese maxim is "*Pon-toun-kiao*" ("Religions are many, reason is one: we are all brothers"). This phrase is on the lips of every Chinese, and they bandy it from one to the other with the most exquisite urbanity. It is indeed a clear and concise expression of their feelings on religious questions. In their eyes, a worship is merely an affair of taste and fashion, to which no more importance is attached than to the color of garments.

Let it not be forgotten that we are dealing with a race which holds among other singular tenets the abhorrent doctrine that woman plays no other part in nature than as an indispensable necessity for the propagation of mankind; that she has no soul, but is merely a necessary animal adjunct in the human race, serviceable for its perpetuation, for the gratification of the animal passions of men, for the common drudgery of the household or field labor, but not worthy of education and not eligible to salvation as taught by any scheme of future existence within their belief or knowledge. Let us make no mistake about this. It is in proof in the writings of Chinese missionaries and travelers of every nationality. It is the one point on which they all agree. It is the belief and teaching upon which the practice of infanticide prevails in China, in which the female child is invariably the victim and the sacrifice. Bought and sold, kidnapped and forced into a life of prostitution and helpless misery, woman is indeed among the Chinese an object of pity and commiseration. The evidences are constantly before our eyes in our own country, wherever the Chinese are gathered in communities, that her lot here is in no way ameliorated, nor have her Christian surroundings so far, in any perceptible degree, tended to work her elevation or emancipation. It is a work that must first be successfully begun and carried out before we may indulge in the idle dream of Chinese conversion to the doctrines of Christianity. It is another—if not the most important—factor in the Chinese problem which we are called upon to solve, in so far as the Chinese who are to remain among us are concerned, and adds perhaps the most serious complexity to the puzzle.

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* Since the foregoing was written, Canon Taylor, of the English Established Church, in an article in the "Fortnightly Review," entitled "The Great Missionary Failure," furnishes the following interesting statistical information: "China is perhaps the most disheartening case. The population is reckoned at 382,000,000. The annual increase by the excess of births over deaths would be about 4,580,000. Last year the Church Missionary Society baptized 167 adults. At this rate it would take the Church Missionary Society 27,000 years to overtake the gain to heathenism in a single year! If the population were stationary, it would take more than 1,680,000 years to convert the Chinese Empire. If the progress is slow, the expenditure is lavish. Last year in Ceylon 424 agents of the Church Missionary Society spent £11,003 16*s.* 7*d.* in making 190 adult converts out of a population of nearly three millions, but the relapses were more numerous than the converts, as there was a decrease of 143 in the native Christian adherents. In China 247 agents of the same society spent £14,875 3*s.* in making 167 converts out of a population of 382,000,000. In northern India (Bengal, Bombay, and the Northwest Provinces) 715 agents made 173 converts, at a cost of £34,186 2*s.* 5*d.* And many converts are paid. In Hong-Kong there are 94 communicants and 85 paid native agents. In Egypt and Arabia there are 10 communicants and 7 paid native agents. In Yoruba, after forty years of labor, not five per cent of the people are converted, human sacrifices are not discontinued, while the native Christian adherents decreased last year by 885."

The children born upon our soil so far are in the main illegitimate, and in all cases are, by the very nature of their surroundings, barred out from possible education in common with the children of our population in general. There can therefore be no common school system which in its proper sense can be made applicable to them. What then occurs? Either they must be debarred from being educated at the public expense, or a school system must be devised for their own separate teaching. In the latter case there will no longer be a *common* school system, but a line of class distinction will at once be drawn, and the virtual introduction of the caste system will begin. Will not this even build higher still the barrier between Christianity and idolatry, and will not the way of conversion be made still more difficult than before?

It has been truly said of the Chinese as they exist in the San Francisco colony that "they are not only not amenable to law, but they are governed by secret tribunals unrecognized and unauthorized by law." These tribunals "levy taxes, command masses of men, intimidate interpreters and witnesses, enforce perjury, regulate trade, punish the refractory, remove witnesses beyond the reach of the courts, control liberty of action, and prevent the return of Chinese to their home in China without their consent." And this system grows out of the inherent quality of the Chinese mind. It is part and parcel of their natures to be their own masters, to acknowledge no law or rule of action not of their own making. It is this quality of mind, this ancestral inheritance, that must be eradicated and changed before the Chinese can be made to stand upon an equality before the law with other American citizens. It adds another to the many complications of the Chinese problem which is before us for solution, and as it involves a change of natural proclivities which can not be brought about except by the slow evolutionary process through successive generations, it becomes possibly the most serious complication of all. But literally these complications are endless, and do not admit of further elaboration in this paper. They suggest the conclusion that the Chinese question, whether exclusion excludes or not, is so far from being finally disposed of, that it is now assuming its gravest and most important aspect. While we may well wish that the Chinaman might have been permitted to remain at home to enjoy his opium *cum dignitate*, yet regrets on this point are worse than useless, and the question now is, that, having him, like the poor, always with us, what shall we do with him?

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GOVERNMENTAL AID TO INJUSTICE.

BY GEORGE M. WALLACE.

PLACED in a world in common, with every degree of financial ability, positive and negative, we are all spurred on by common necessity, by common desire to escape hunger, cold, disease, and death. To this end we enter the business arena and struggle for bread, each offering for sale something he has himself produced in return for like offerings from others. In this arena we find the successful business man offering for sale a hundred tons of steel rails; beside him is a slender girl offering for sale the labor of her hands for ten hours. The commodity offered by each, by each has been produced: the business man's from a hundred tons of coal burned beneath a dozen boilers, perhaps; the young girl's, worked up in a physiological laboratory, comes from a night's rest, a morning and midday repast.

So long as each has produced his and her own offering, and is allowed to enjoy to the full the fruits of his and her own effort, no one shall say him nay if the business man offsets the muscular energy of the young girl by a thousand or by ten thousand fold. Neither economics nor morals shall stint or limit the business man's returns so long as legitimate business methods alone are adhered to, so long simply as business men are content to take what they have produced, and leave to others their own productions. In a purely democratic country each should enjoy all the freedom which is consistent with a like amount of freedom in others, and each should be given full right to the enjoyment of the fruits of his own effort. The maintenance of this status is the best function and only justification of government. Just as church and state, or science and religion, are best separated, so politics and business should be divorced. The latter, depending on the natural resources of a country, should not be made to fluctuate with every breath of public opinion, the medium on which politics depends; while for government to step into the business arena and assist one party or the other is as immoral, financially, as for the umpire of a ball-game to play upon one side or the other by partial decisions.

In 1887 steel rails were selling in the markets of the world for twenty dollars per ton. Like a wall around the United States, there was a protective duty of seventeen dollars, and steel rails were selling within this country at thirty-seven dollars per ton. Protection removed foreign competition, a trust removed domestic competition, and the two carried prices to the very limit. Here the business men of Pittsburg had gone out of the purely business arena—they had stepped into politics, had got the United States Government into their business as a business factor, and, securing to themselves the surrender of a part of its taxing power, they had government, which is only just when impartial, playing on their side.

Now note, the business man by government partiality gets thirty-seven dollars per ton where otherwise, or in the markets of the world, he could only get twenty. He has a rise in price on steel rails of seventeen dollars per ton. The young girl has worked a day and got a dollar; she wants ten yards of calico, and goes to a store and gets it at ten cents a yard, and pays the dollar her day had produced. The store-keeper would have charged only nine cents a yard but for extra freight he had to pay; the railroad charged extra freight because of the increased cost of its steel rails. In other words, when, by government interference on behalf of the business man, the price of steel rails was carried from twenty to thirty-seven dollars per ton, the railroad got it back by increased freights and the merchant by increased prices. The young girl got it back from nowhere; her ten cents was passed over to the merchant, who passed it over to the railroad, which passed it over to the business man.

Government, which can produce nothing, has wrought a different distribution of wealth; the business man gets all he earns as before, but also gets one tenth of the earnings of the young girl. Government is no longer just, because no longer impartial; the girl is no longer free, because not permitted to enjoy in full the fruits of her own labor. Ten cents apiece, once a year, from a hundred thousand persons, made up of young girls, boys, babies, sick and old folks, and the poor generally—for the tax can always be landed upon the poor at last—make ten thousand dollars. That ten cents to the young girl was blood-money; she will be less well clothed, less well nourished, and, taken from supplies already scant, it may mean hunger, cold, and even death to her. To the business man it may mean a cigar, or a stick of chewing-gum for his child, or, put with other forced contributions, the total may take his daughter to Europe for a pleasure-trip.

Here is one of our great captains of industry, assisted by accumulated capital and corporate franchises as well as the ability which makes him a captain of industry, competing in the industrial arena for the necessaries and good things of life with a frail girl who has only a one-girl power to depend on, and of the two he it is we find asking government aid, and aid to do what? Why, to take away to himself all his own and a part as well of the poor girl's earnings.

This in what ought to be the manliest country in the world, on the part of that section of our manhood best fitted by nature for the financial struggle for bread, and aimed by these financial giants at the weakest section of the community. We may talk about the ferocity of the Northmen tossing up babies and catching them on their spears, or about atrocities practiced in Russia to-day; we may imagine a Sullivan calling for steel knuckles with which to encounter a seven-year-old boy; but we can not believe that American manhood will not some time rise above the unparalleled meanness of the protective tariff.

ISRAELITE AND INDIAN: A PARALLEL IN PLANES OF CULTURE.*

By GARRICK MALLERY.

II.

PARALLEL MYTHS.—The early religious opinions and practices of all peoples appear in myth and by myths are explained. When a religion has endured among a people for a long time after the use of writing has become general, its myths are collected and collated and formed into a system. This system generates dogmas which require support from glosses on the text of the original myths; indeed, these texts are often buried under a mass of homilies and predications, or, when still used in their purity, are interpreted *ad libitum*. Such is the history of the myths and the religion of Israel.

The Indians have myths and legends which explain their religious opinions and practices; but, as they did not acquire the art of writing, they did not formulate articles of faith. Their beliefs must be ascertained, therefore, by the collection and study of the myths themselves as now reduced to writing and translated. The comparison of the myths of the Indians with the myths of the Israelites displays striking similarity and exhibits more clearly than a mere statement of doctrines the likeness of the religions of the two peoples. The likeness of the two collections of myths to one another, and their comparison with similar collections from other peoples, indicates that when the same events are represented as occurring everywhere, they really occurred nowhere, but were the mental conceptions of men in the same stage of intellectual culture.

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* Address of the Vice-President of the American Association for the Advancement of Science, Section H, Anthropology, delivered at the Toronto meeting, August, 1889.

It is not necessary to mention deluge legends common in all countries where inundations have occurred, and only a general interest attaches to the mythical culture hero. He was sometimes an inspired man, and sometimes a benevolent god in shape of man, but in his more archaic forms he was a beast with human metamorphoses. He taught all that is known of hunting, fishing, the properties of plants, picture-writing, and indeed of every art, and founded institutions and established religions. After his achievements he generally disappeared with mystery, his actual death being seldom established, leaving a hope of his return as a triumphant benefactor. The legends relating to Michabo, Ioskeha, Hiawatha, and Manabosho will occur to all special students as showing their analogues in the biography of Moses. But the point of peculiar interest is that the myths referred to are not only similar generically, but that they are strikingly identical in their minute details with those of the Israelites. A few of them will be noticed.

It will be understood that in all instances presented scrupulous care has been taken to eliminate European influence and to obtain assurance of the aboriginal and ancient origin of the legends.

An Ojibwa tradition tells the adventures of eight, ten, and sometimes twelve brothers, the youngest of whom is the wisest and the most beloved of their father and especially favored by the high powers. He delivers his brothers from many difficulties which were brought about by their folly and disobedience. Particularly, he supplies them with corn. A variant statue of Lot's wife who, after escaping from the destruction of her village, was turned into stone instead of salt, is still shown near the Mississippi River. The Chahta have an elaborate story of their migrations in which they were guided by a pole leaning in the direction which they should take, and remaining vertical at each place where they should encamp. A still closer resemblance to the guidance of the Israelites in the desert by a pillar of fire is found in the legendary migrations of the Tusayan, when indication was made by the movement and the halting of a star. The Pai Utes were sustained in a great march through the desert by water which continually filled the magic cup given to the Sokus Waiunats in a dream, until all were satisfied; and a similarly miraculous supply of food to the starving multitude is reported by the same people. In the genesis myth of the Tusayan, the culture-hero was enabled to pass dry shod through lakes and rivers by throwing a staff upon the waters, which were at once divided as by walls.

Among the Ojibwa traditions there is a variant of the conception that man could not look upon the form of a divine being and live. According to these traditions the divine beings were obliged to wear veils, and when one of them unintentionally let his eyes fall upon the form of a man the man fell dead as if struck by lightning.

The Midéwiwin rite was granted to the Ojibwa at a time of great trouble, through the intercession of Minabozho, their universal uncle, and at the same time rules of life were given to them, which are still represented in hieroglyphics on birch-bark. They have a resemblance in motive to the Biblical legends and laws. At the time of a great pestilence, which came "when the earth was new," the Ojibwa were saved by one of their number to whom a spirit, in the shape of a serpent, revealed a root which to this day they name the "snake-root," and songs and rites pertaining to the serpent are incorporated in the Midéwiwin.

Mr. W. W. Warren, in his "History of the Ojibwa Nation," tells that he sometimes translated parts of Bible history to the old Ojibwa men, and their expression invariably was, "The book must be true, for our ancestors have told us similar stories generation after generation since the earth was new." Only last year a well-informed representative in Washington of the Muskoki answered questions about the myths and legends of his people by the simple remark: "They are all in the Old Testament. Read them there, without the trouble of taking them down from our people."

SOCIOLOGY.—The golden age of the Israelites, as recorded in the Old Testament according to modified tradition, was the age ending with the Judges. The people lived in a state nearest to their ideal under a supposed theocracy, which really was not instituted until the days of Ezra and Nehemiah. The exploits of Gideon, Jephthah, and Samson are pictures of antiquity equal in grandeur and like in import to those of the Homeric heroes. If the Indians could have written about their own past, they would have portrayed a similar golden age, which, indeed, is mirrored in their traditions and myths.

But it must always be borne in mind that the Indians were not nomads, and were never in the true pastoral stage; hence their tales of the good old times were more archaic than those presented to us in the Israelite records.

Nomadic life requires the possession of either domesticated animals for sustenance or of burden-bearing animals by whose aid fresh game areas may be readily occupied. The persistent nomads—e. g., the Arabs—have possessed both kinds of animals. The Indians had neither. The large majority of the historic Indians never saw a horse until centuries after the Columbian discovery. The Dakota, Comanche, and some other tribes became nomads adventitiously, and only after the introduction of the horse by Europeans. The means of subsistence of these tribes in a nomadic life were afterward increased by their obtaining firearms.

The pastoral stage also depended upon the possession of some of the animals mentioned. It expedited the transition of the Israelites from savagery to barbarism, but it was not experienced by the Indians. Therefore, supposing that the two peoples were at one time equally advanced in culture, it might well have required three thousand years longer for the Indians to reach the stage in which they were discovered than for the Israelites to attain to the culture shown in the days of the Judges.

At the time taken for proper comparison between the two peoples, which has before been designated, both were living under the clan or totemic system, which was formerly called the gentile system.

A clan is a body of kindred in which kinship is established by laws now long disused, and so strange to our present ideas as to be comprehended with difficulty. Some of the more salient features of the system appear in the division of the people into tribes which are interpermeated by clans, with special rules of government, adoption, punishment, protection, property, and marriage.

The totemic stage was first intelligently noticed among the aborigines of America and Australia, and typical representations of it are still found among them. In Australia it is called *kobong*. An animal or a plant, or sometimes a heavenly body, is connected with all persons of a certain stock, who believe that it is their totem, their protecting daimon. They regard themselves as descendants of the totem, and they bear its name. The line of descent is normally female. When a clan becomes dominant, its totem daimon prevails together with it, and commands the worship of all the clans or tribes in the group, the daimons of other clans and tribes becoming subordinate.

The clan system, lately found in actual force in two large geographic divisions of the world, has preserved a clew to the moldered maze of man's early institutions. What is now known of the clans, tribes, and league of the Iroquois explains what was formerly mystical about the tribes of Israel.

Each clan or tribe took as a badge or objective totem the representation of the totemic daimon from which it was named.

It was generally an animal—e. g., an eagle, a panther, a buffalo, a bear, a deer, a raccoon, a tortoise, a snake, or a fish, but sometimes one of the winds, a celestial body, or other impressive object or phenomenon.

The Israelites had such badges or totems which have been called standards. The blessings of Jacob and of Moses, which mention several of them, were not merely metaphoric. In the blessing of Jacob, Judah is named as a lion, Issachar as an ass, Dan as a serpent, Naphtali as a hind, Benjamin as a wolf, Joseph as a bough. In that of Moses, four such names occur—Ephraim as a bullock, Manasseh as a bison, Gad as a lion, and Dan as a lion's whelp. From all the evidence on the subject there is reason to believe that these were the leading totems in the tribes mentioned, and the discrepancies in the lists may be accounted for by the fact that the head clans in some tribes had changed in the interval.

David seems to have belonged to the serpent stock. The most prominent among his ancestors bore a serpent name. Some passages in his life show his connection with a serpent totem.

Critics have doubted whether Moses was as much opposed to idolatry as is asserted in the records, for a brazen serpent, perhaps an ancient idol of Jahveh, said to have been set up by him, was in existence until the reign of Hezekiah, who broke it into pieces. True, it may have been an idol of Jahveh, or perhaps it was worshiped as a teraph; but it may have been simply a totem. The lifting up of the brazen serpent by Moses in the wilderness may be more consistently explained by totemism than by idolatry in its usual sense.

Government.—The Israelites in their normal condition were governed by a number of their elders who were presumed to have the greatest wisdom and experience. Special powers were conferred in emergencies upon one man and were intended to be of short duration, but while they lasted they were dictatorial. The judges were despots without a standing army or an organized government. Their selection was due neither to inheritance, to suffrage, nor to violence, but to personal superiority in strength, wisdom, and courage. The usual result was, that the power gained by a ruler was held during his life, and it was sometimes contended for by one of his sons with temporary success. The government of the Indians was substantially the same.

The alliance of the tribes was loose. They seldom hesitated to make war upon one another. Even after nationality had been initiated, the genius of David and the magnificence of Solomon could not permanently weld them together; and doubtless without the later and cohesive establishment of Jahvism they would have often, though perhaps but temporarily, fallen back into an incoherent state. The Indians did not gain such a conservative bond, and the alliances of their tribes were more loose and transient.

The characteristics of the Israelite and of the Indian, as of the Homeric Achæans and of the extant Bedouins, were predatory. The tribe and its clans, with their occasional allies, went forth against the rest of the world.

In the investigation of totemism among the Israelites it is important to observe its continued existence in Arabia, because the state of society there still remains more primitive than that prevalent in the land of Israel even at the time of imposing antiquity when the Old Testament was written.

A large number of tribes having animal names are still found among the Arabs. Some of these tribal names are Lion, Wolf, Ibex, She-fox, Dog, Bull, Ass, Hyena, and Lizard. The origin of all these names is referred by the people to an ancestor who bore the tribal or gentile name. The animal names given in the tribal genealogies are also often found belonging to sub-tribes, the same animal name sometimes occurring in subdivisions of different tribes. These particulars correspond with the Indian clan system.

The tribes of the southern and eastern parts of Canaan had affinities both to Israel and to the Arabs. The Arab princes of Midian were The Raven and The Wolf—heads of tribes of the same names. More than one third of the Horites, the descendants of Seir the He-goat, bear animal names; so do the clans of the Edomites. The real name of Moses's father-in-law is in dispute, but he had some connection with the Kenites. The list in Genesis xxxvi is a count of tribal or local divisions and not a literal genealogy. It is full of animal names. The Antelope stock was divided over the nation in a way only to be explained on the totemic and not on a genealogic system. The same names of totem tribes that appear in Arabia, reach through Edom, Midian, and Moab into Canaan, where they show local distribution, which is intelligible only on the assumption that the totemic system prevailed there also when the first books of the Old Testament were written.

Prof. Robertson Smith gives a select list of about thirty persons and towns in point, bearing names derived from animals and plants. Dr. Joseph Jacobs has expanded that list into a hundred and sixty such names, though he considers their importance to be lessened by the frequency of such names in England, forgetting, apparently, that the clan system also existed among the ancestors of the English people.

The twenty-sixth chapter of Numbers gives the clans of the Israelite tribes. Altogether seventy-two clans are mentioned, and of these at least ten occur in two tribes, among which the Arodites or Wild Ass clan, found both in Gad and in Benjamin, should be noted. Other clans also have animal names: the Shillimites or Fox clan, of Naphtali; the Shuhamites or Serpent clan, of Benjamin; the Bachrites or Camel clan, of Ephraim and Benjamin; the Elonites or Oak clan, of Zebulon; the Tolaites or Worm clan, of Issachar; and the Arelets or Lion clan, of Gad.

A special suggestion comes from the tribe of Simeon. In the blessing of Jacob, Simeon is coupled with Levi as a tribe scattered in Israel. Some Simeonites lived in the south of the territory of Judah, but they do not appear there as an independent local tribe. It would seem that Simeon remained as a divided stock, having representatives through the female line in the different local groups. When the old system was transformed, Simeon lost importance and ultimately dropped from the list of tribes. The name of the tribe was lost but not the people, as has been noticed also in careful statistical examination of the Indians.

The tribe of Judah received the powerful accession of the Dog tribe, the Calebites (to be again mentioned), among whom there were many animal names.

In view of the above, and the additional fact that the early Israelites freely intermarried with the surrounding nations, it becomes highly probable that the totemic system of those neighbors existed in all Israel, as was obviously the case in Judah.

Punishment.—In the stage of barbarism man belongs not to himself, but to his clan and tribe. In civilization crime is the act of an individual for which he is responsible to the whole community, and there can be no crime without a malicious intent. In the totemic stage the clan was responsible to all its members and to all other clans for the offense of any of its own members, and the act itself, not its intent, constituted the offense. Hence the rules respecting obedience, punishment, and protection differ from those of civilized man.

Punishments among the Indians were chiefly death or expulsion from the tribe—the latter, from the unprotected state of the offender, being tantamount to death. The code consisted in the application of the *lex talionis*. The vengeance of blood for homicide was exacted as a clan duty. It was executed by the clan of the person killed, generally by the nearest of clan kinship, and it was required even if the death were by accident, unless the killing was condoned by payment. Among the Israelites the *lex talionis* was likewise the fundamental law, and the duty of blood revenge also devolved on the kin by the mother's side—i. e., the kindred according to the normal clan system.

Sanctuary.—The doctrine that no crime could be individual, but might be committed against a clan by a clan through one of its members, rendered it necessary to have some special provision to restrict vengeance and maintain peace. Hence the right of sanctuary, which appeared later as a prerogative of religion, was in its origin sociologic.

The avenger of blood among the Indians generally had the right to slay the criminal if found within a specified time, for instance, two days after the act; but if he should escape beyond such period, the avenger could no longer pursue, and was himself liable if he should persevere. The clan or clans concerned interfered at that stage in prescribed modes. Among some tribes localities (called by Adair the "cities of refuge") were designated, in which the accused could remain in safety until the general settlement of accounts at the next annual festival. Compare Numbers xxxv, 12: "And they shall be with you cities of refuge from the avenger; that the man-slayer die not, until he stand before the congregation in judgment."

The functions of the avenger of blood are only referred to in the Pentateuch, but were well known in ordinary cases. The law treats of the exceptional circumstances of an accidental homicide. There is a trace, in Deuteronomy xxiii, of the general communal sanctuary in Israel. It enacts that any town or village shall be an asylum for an escaped slave. In Exodus xxi, the altar (presumably any one of the numerous village altars) is mentioned as a refuge. In the cities of refuge the sanctuary was used only for the mitigation of the revenge of blood.

A mode of bringing to notice the barbarian stage of the Israelites at the time under consideration is to translate into English familiar personal names from the Old Testament, such as the Dog, the Dove, the Hyena, the Lion's Whelp, the Strong Ass, the Adder, and the Running Hind. This brings into immediate connection the English translation of Indian names, such as Big Bear, White Buffalo, Wolf, Red Cloud, Black Hawk, Fox, Crow, and Turtle. Such Israelite names were probably of Gentile origin, that is, from the clan or gens, for the Israelites were surely Gentiles in the true sense, although later they abjured the charge. But individuals among them may also have adopted such names because they could be represented objectively. Such selection is made by some Indians apart from their totemic designation. Indians possess very few names that can not be represented in pictographs; and the very large topic of tattooing is connected with this device antecedent to writing. The compilers of the Old Testament probably desired to break down a former practice, as is shown in Leviticus xix, 28: "Ye shall not print any marks upon you." And there are other similar indications.

Adoption.—The early history after the exodus shows many cases of adoption from among the neighboring tribes in which the captive or the stranger adopted became a member of one of the clans. This was an essential part of the totemic system as is noticed universally among the Indians. Without membership in a clan there could be no status in the tribe.

Caleb is first known as the son of Jephunneh, the Kenezite. Next he appears as a chief of the tribe of Judah; finally, in the book of Chronicles, his foreign descent is lost. He becomes Caleb, the son of Hezron, the son of Judah. This is an instance of adoption and is not contradictory. He is first described in accordance with his actual descent, but when adopted with his family and followers, who probably formed a sub-clan, he would be called by the name of the family that adopted him.

The whole population of the country which, according to Deuteronomy, was doomed to be exterminated, slowly became amalgamated with the invaders. In this way alone their rapid increase can be accounted for.

The doctrine that no quarter should be shown to the enemy and no alliance should be made with the Goim (a word meaning the "nations," with the implication of "heathen") was not established until the late prophetic influence. The use of the word Goim dates from the ninth century B. C. It is gratifying to be convinced that the stories of the wholesale extermination and cruel outrages injected into the historical narrative were afterthoughts intended to be examples for the future, and that they never actually occurred. If the stories are true, the brutality of the Israelites to the conquered was more horrible than that of the Indians, among whom captivity was tempered by adoption.

An interesting custom of the Indians connected both with the rite of sanctuary and that of adoption is that called by English writers "running the gantlet." When captives had successfully run through a line of tormentors to a post near the council-house, they were for the time free from further molestation. In the northeastern tribes this was in the nature of an ordeal to test whether or not the captive was vigorous and brave enough to be adopted into the tribe; but among other tribes it appears in a different shape. Any enemy, whether a captive or not, could secure immunity from present danger if he could reach a central post, or, if there were no post, the hut of the chief. A similar custom existed among the Arikara, who kept a special pipe in a "bird-box." If a criminal or enemy succeeded in smoking the pipe contained in the box, he could not be hurt. This corresponds with the safety found in laying hold of the horns of the Israelite altar.

Land.—In the earlier history of the Israelites there could be no individual property in land—it belonged to the clan, as it did among the Indians. After arriving at sedentary and national life the Israelites found it expedient to permit a compromise between the permanent possession of land by the clan and a right of individual occupancy for periods sufficient to offer a proper stimulus for improvements. This was done by the institution of the Sabbatical year or the year of jubilee. The Indians, not having reached the true sedentary stage (except in rare instances), were not obliged to invent that device. Thus it holds true among both peoples that no man could acquire an absolute property in land. The estate was not in him but in his clan.

Forbidden Food.—The Indians long observed a prohibition against killing or eating any part of the animal connected with their totem. For instance, most of the southern Indians abstained from killing the wolf; the Navajo do not kill bears; the Osage never killed the beaver until the skins became valuable for sale. Afterward some of the animals previously held sacred were killed; but apologies were made to them at the time, and in almost all cases a particular ceremony was observed with regard to certain parts of those animals which were not to be used for food on the principle of synecdoche, the temptation to use the food being too strong to permit entire abstinence. The Cheroki forbade the use of the tongues of the deer and bear for food. They cut these members out and cast them into the fire sacramentally. A practice reported this year as still existing among the Ojibwa is in point, though with instructive variation. There is a formal restriction against members of the bear clan eating the animal, yet by a subdivision within the same clan an arrangement is made so that sub-clans may among them eat the whole animal. When a bear is killed, the head and paws are eaten by those who form one branch of the bear totem, and the remainder is reserved for the others. Other Indians have invented a differentiation in which some clansmen may eat the ham and not the shoulder of certain animals, and others the shoulder and not the ham.

The Egyptians did not allow the eating of animals that bore wool. This prohibition has been attributed to the sacred character of the sphinx, and it has other religious connections. It is supposed by some writers that the legislation of Moses with reference to forbidden food was aimed to antagonize social union with the Egyptians by prohibiting to the Israelites edibles generally used by the Egyptians, and *vice versâ*. It is true that some kinds of food forbidden to one of these nations were allowed to the other, but the rule was not general, and in particular the abstinence of both peoples from swine is inconsistent with the hypothesis. A more conclusive criticism is that the legislation so interpreted would have been too late for application. The Israelites had left Egypt before even the alleged time of its promulgation.

The survival of totemism may be inferred from the lists of forbidden food in Leviticus xi and Deuteronomy xiv. It would appear that about the time of the exodus the Israelites were organized on the basis of families or clans tracing through female lines, and named Hezir (swine), Achbor (mouse), Aiah (kite), Arod (wild ass), Shaphan (coney), and so on. Each of the clans refrained from eating the totem animal, or only ate it sacramentally. As the totemic organization declined, the origin of the abstinence would be lost, but the custom lasted, and when the legislation was codified it was incorporated in the code. The hypothesis would explain certain anomalies in the list—e. g., coney, or rock badger, for which no other explanation deserving attention has been given. The division into clean and unclean food by the two tests of cloven foot and rumination was a later induction from the animals regarded as *tabu.* This is confirmed by the want of any systemization in the list of birds given in Leviticus.

It would accord with other examples in totemism that animal names connected with the animal worship before mentioned should be adopted by clans, and by individual men among the Israelites. There is some evidence that men, bearing a common animal stock name, though in different tribes or nations, recognized a unity of stock. Our most definite information on the subject is derived from Ezekiel viii, which indicates that the head of each house acted as priest, the family or clan images, which are the objects of idolatry, being those of "unclean" reptiles or quadrupeds—i. e., those which are prohibited from use as food. Although the whole inference of Prof. Smith on this subject is not admitted by Dr. Jacobs, his objection is to the survival, not to the early existence, of the cult.

No satisfactory explanation of the Israelite division between clean and unclean animals, apart from that afforded by the totemic system, has hitherto been made. No rational motive can be assigned for the avoidance of certain animals, in themselves hygienically good. The explanation that swine's flesh was liable to bring disease, and therefore was prohibited for a sanitary reason only, covers but a small part of the subject and is not in itself satisfactory. The meat of the hog is, in fact, as wholesome in Syria as it is in Cincinnati, and the discovery of trichinosis had certainly not been made in the times under consideration. The avoidance of all meat, indeed of all food, for purposes of fasting and producing ecstasy, is in a different category and has already been mentioned.

Marriage.—The laws of marriage in the stage of barbarism are intricate, but attention may be directed to a few points which strongly distinguish them from the marriage laws of civilization. Their most general characteristic is the regulation of marriage within strict limits of conventional kinship.

The levirate, named from the word *levir*, a husband's brother, is in brief the customary right and obligation combined of a brother—normally the eldest surviving brother—to marry the widow of his deceased brother. Prof. E. B. Tylor reports that this law appears among one hundred and twenty peoples—i. e., in about one in three of the distinct peoples of the world. It was almost universal among the Indians, sometimes with additional duties and privileges. A widow, as a rule, could not marry any one but her deceased husband's brother except on his refusing to marry her, nor until after a long time of mourning, or more properly of ordeal, after which she could be freed from the *tabu*.

In several tribes marrying an elder sister gave to the husband rights over all the other sisters of the wife. Sometimes the son-in-law, especially when he married the eldest daughter, became entitled to all the younger sisters of his wife at his option. Other men could not take them except with his formal consent. This right of the son-in-law to all the unmarried younger sisters sometimes continued after the death of the first wife. Not unfrequently a man married a widow and her daughters at the same time.

Among the Israelites it was common to have several wives of equal status, who often were sisters. A widow had a right to appeal to her brother-in-law, or some member of her husband's family, to provide her with a second husband, and an evasion of the duty *in personam* was a gross offense. Deuteronomy xxv shows the degrading terms of the formality by which alone the brother-in-law could be freed from the obligations of marriage and the widow be allowed to marry another man. Judah admitted that Tamar's conduct was perfectly correct. It was but a legitimate extension of the levirate law.

There is the clear statement in Leviticus that the Egyptians and the Canaanites formed such marriages as were in accordance with the totemic system, but which were made incestuous by the Israelite law. The laws of incest given in Leviticus are probably later than the code of Deuteronomy, in which the prohibition is directed against marriage by a man with his father's wife. That precept denounces the practice in Arabia by which the son inherited his father's wife.

In the framework of the Deuteronomic code there were three incestuous prohibitions, viz., father's wife, sister, and wife's mother. To these offenses Ezekiel adds marriage with a daughter-in-law. According to the prophets, all those forms of *quasi*-incest were practiced in Jerusalem; and the history indicates that all at some time were recognized customs. The taking in marriage of a father's wife was not wholly obsolete in the time of David.

As regards the Israelite system of descent in the female line, it may be noticed that the children of Nahor by Milkah were distinguished from his children by his other wives. Rebekah's descent is practically valued as descent from Milkah, and the family or clan connection is traced entirely through Milkah and Sarah. Their rules of kinship regarding what we now call incest are partly indicated by the following instances: Moses' father married his father's sister; Nahor married his brother's daughter; Abraham married Sarah, the daughter of his father but not of his mother.

A passage in Judges relates to exogamy, recording that Ibzan had thirty sons, and also thirty daughters whom he sent abroad, and took thirty daughters from abroad for his sons. But exogamy could not be kept up after the Israelites had become mainly an agricultural people, and in the times of the kings only survivals of it remained.

Mr. John Fenton, in "Early Hebrew Life," makes some acute remarks upon the story of Lot's daughters, but he did not exhaust the subject. According to the clan system, it was not only proper for Lot to marry his daughters, but under the circumstances it was obligatory upon him to do so. The logical propriety of the marriage of a father to his daughters, on the ground that they did not belong to the same clan, is clear, and the practice exists to-day among a number of the tribes of Indians not much affected by European intercourse. A father was not of kin to his own children. They belonged to the mother's clan, and not to his. An interesting example of this clan law is furnished by Dr. George M. Dawson as still existing among tribes of British Columbia. A certain rich Indian would have nothing to do with the search for his aged father, who was lost and starving in the mountains. He did not count his father as a relative, and said, "Let his people go in search of him." Yet that son was regarded as a particularly good Indian.

There are other instances in which the son would fight against the father to the death. Such cases would occur where, according to the obligations of clan law, a son married a woman of a clan other than that of his father and went to live with her people; and when there was warfare between her clan and that of his father, the son was by association expected to fight against his father. The real tie of blood gave no reason why he should not be alien and antagonistic to his father and his father's clan.

But it is true that, in many tribes of Indians, since they have been observed by Europeans, the marriage of father and daughter has been very rare. It may be suggested as a reason that a gradual change has occurred from the mother-right to the father-right, in which the attitude is reversed; but practically the fact that, by treating the daughter as an object of value or merchandise, either the father or mother could secure presents from the suitor, naturally tended to break down this part of the clan marriage system before any other, and, the custom ceasing, the practice became wrong. So it is true to-day among Indians, as it was in a much more marked degree among the Israelites at the time of the compilation of the existing version of the Old Testament, that the marriage of a father and daughter is reprobated. In this connection it is instructive to notice that the Navajo have a myth, undoubtedly genuine, that in the old time one of their race took his daughter to wife, and their offspring became the ancestor of the Utes, the hereditary enemies of the Navajo. This is a parallel with the stigma inflicted upon the Moabites and Ammonites, who were the descendants of Lot and the enemies of the Israelites who wrote the history, but yet were recognized by the latter as of the same stock.

The part of the story of Lot as it appears in our version, which tends strongly to show its later manipulation, is that the authors of that version, having at that time the idea of a horrible incest, explained that the man, specially designated by tradition as eminently good, was guilty only because he was betrayed through intoxication. They were obliged, in accordance with one tradition, to make him the ancestor of Moab and Ammon. By another tradition he was left without any sons and no wife, the two daughters being all of his family who survived the destruction of Sodom. They reconciled their data, therefore, by the excuse of intoxication, but there was no occasion for such excuse. In the age to which the tradition related the transaction was perfectly proper, did not involve sexual passion, and was required by law to keep up the stock. The clan rules had been forgotten when the book of Genesis was written.

In the stage of barbarism the marriage of brother and sister was common all over the world. Where polygamy existed, as was the case among the Israelites, and probably among all the Indians, a man, according to the rules of the totemic system, could not marry into his own clan. If he took several wives, they would sometimes be of different clans, not only from his own, but from one another. In such cases, the child of the wife of clan A was not of the same clan as the child of the wife of clan B, and they could marry. The marriage of uterine brothers and sisters was not consistent with the clan rules.

Writers on the clan system have extolled it as a system showing profound physiological insight respecting the supposed evils of inbreeding; but the best and latest physiologists doubt whether inbreeding is bad, unless there is a taint of blood which should prohibit the marriage of either party to any one. A true understanding of the clan system would have shown that inasmuch as it certainly permitted marriage between a man and his half-sister, and between a man and his aunt, his father's sister, if not the more violent case of marriage between father and daughter, it did not accomplish that for which it has been so highly praised.

The late prohibition of a man's marriage to his deceased wife's sister can not be successfully defended on any principle of physiology or sociology. It is a blunder that perhaps arose in the transition stage from the matriarchate to the patriarchate method.

CONCLUSIONS.—The Indians have been characterized as peculiar among the races of men. One school of writers has pronounced them to be *feræ naturæ*, and wholly incapable of receiving civilization. Others have held the opposite view, that they were eminently spiritualistic, as was proved by their having preserved the pure pristine faith to a degree beyond all other secluded peoples. Both of these assertions are disproved. When Indians have been allowed reasonable opportunities, they have advanced in civilization, and have thriven under it. While their religion may in one sense be pristine, it does not differ materially from that found in many other regions.

The peculiarity of the Semites, and especially of that branch of them lately styled the Syro-Aramæans (which is only an ethnographic name including the Israelites), has been accepted as an axiom. It was pronounced that they were specially adapted to a spiritual religion; that whether through an exclusive revelation, or because their racial constitution was exceptionally receptive to such revelation, their idiosyncrasy disposed them readily to spiritual ideas, which to modern minds means monotheism. This is not the record of the historical books of the Old Testament, even after their manipulation. The prophets of Israel declared the exact contrary; they denounced their own people as rejecting spiritual truth, and as not deserving the favor of Jahveh.

The historical books of Israel which we possess are not historical records, but are historic legends reduced to writing by writers who had sometimes political and sometimes religious ends in view. The argument of those tales is that all the people habitually worshiped Jahveh, and him alone, during which normal period they were prosperous, but that sometimes under evil influence they abandoned him and fell into disaster, until, after sufficient chastisement, they returned to the true worship. The historic truth is that the old Israelites, when disasters came, as they always do come, gave up the worship of their national god as not a success, and tried the gods of their neighbors. They returned to Jahveh because the other gods did not satisfy them any better. In fact, the people had no fixed or distinct faith, and it is not correct to accuse them of backsliding when they were only vacillating.

The prophets tried to pull the Israelites too rapidly through the zoötheistic and physitheistic stages into monotheism, and spasmodically succeeded; but the body of the people never reached the stage of monotheism until after the Babylonian captivity. Most writers have explained this on the theory that the terrible chastisement of that captivity finally brought them to submission; but it is more probable that their forced relations with their more cultured conquerors gave them new ideas never before entertained, which infused modifications into their religion. The resulting combination produced those characteristics of that religion which have been regarded as the most admirable.

The general account of the Israelite lapses is not unlike that given in modern times by missionaries, who also have been impetuous in attempting the instantaneous transport of Indians through stages that are marked by ages. Tribes of Indians have been converted, and they were reported and recorded as being in that permanent condition. A few years later, from some dissatisfaction, they returned to their shaman and their dreams, which return was then reported as a lapse. It was not, in fact, a lapse, but the claim that they had been converted was premature. There is, however, this distinction between the Israelites and the Indians: that the former were allowed to return to Palestine and carry out their old ideas with improvements; while the Indians, remaining under the same foreign influences and continually growing weaker, were forced to abandon all their faith and to accept that of their conquerors without composition.

The stories of the conversion of Indians by thousands would seem false to one who did not know that they were ready to believe any new thing because they before had no fixed belief. The record of the Israelites is not so clear, because old; but they surely adopted the Satanic doctrine and the "Mosaic cosmology," and continued adopting foreign beliefs until a late date in their history.

The most judicious remarks ever made by missionaries were those of the Rev. Messrs. D. Lee and J. H. Frost, who, after ten years in Oregon of what has been considered successful work, announced their abandonment of their former tenet that if the heathen were converted to Christianity civilization followed of course. They confessed that civilization must begin before Christianity could even be understood. Acute travelers throughout the world have perceived the same fact; and it is not a too violent simile to say that Christianity, belonging to the plane of civilization and to that only, sits on a savage or barbarian as a bishop's mitre would on a naked Hottentot.

The Israelites were not suddenly lifted from their barbarian condition. It was not possible. As regards the culture strata we may take a lesson from geology. Coal is not found in the Silurian formation, therefore wise miners do not look there for coal. The higher mammals are not found earlier than the Cenozoic, though their precursors are in the Jurassic. Man in the savage stage may be examined in the same spirit as the Jurassic stage is studied to trace what may afterward appear in the barbarian and Cenozoic, and is developed in the present epoch; but to search for the complete ideas of civilization in the period of barbarism would be as judicious as to dig for manuscripts among the workshops of flint arrow-heads.

The beliefs and practices of both the Israelites and the Indians were substantially the same as those of other bodies of people in the same stage of culture. They were neither of them a "peculiar" people.

There is, racially, no peculiar people in the sense intended. Mankind is homogeneous in nature, though its divisions at any one time are found in differing and advancing grades of culture. Such advancement has been from causes known to be still in continuous operation. What is called blood in a racial sense may be likened unto the water of the earth: as the water comes from the clouds it is chemically the same, and it is subjected, wherever it is, to the same laws. The early course of a rill may be turned by a pebble, and from the elevations and depressions met it may become a lake, or a river, or a stagnant marsh. From the character of soil encountered it may be clear or muddy, alkaline, chalybeate, or sulphurous. In one sense, which belongs to modern and not to ancient history, the Jews are a peculiar people, from the fact that for many centuries, until lately, they proclaimed themselves to be such, and observed religiously the doctrine about the Goim, and therefore did not intermarry with other peoples; but that should not be a reason for their boasting. Persecution made them pariahs and other peoples would not intermarry with them. During recent centuries the so-styled purity of their race has been kept up by isolation, but the assumption of great purity in the stock at the Christian era is not tenable. Now that their prejudices and those of the Goim against them are dissolving, it is probable that what has been improperly called the Jewish race will disappear by absorption as the Indians are now disappearing. To renew the simile, both Israelite and Indian will be lost in the homogeneous ocean which all mankind seems destined to swell.

It will be noticed that this presentation of views practically ignores the scholastic divisions of mankind into distinct races. The result of my own studies on the subject is a conviction that all attempts at the classification of races have failed. The best statement of the condition of scientific opinion regarding such classification may be taken from the address of Prof. W. H. Flower to the Section of Anthropology of the British Association for the Advancement of Science. He says: "I am compelled to use the word race vaguely for any considerable group of men who resemble each other in certain common characters transmitted from generation to generation." Some satisfactory solution of the problem may be made in the future, but for the present the most useful direction of the work of anthropologists is not in attempts to establish racial divisions, but in the determination of the several planes of culture with recognition of specific environments.

A rabbinical legend tells that Lot was the first to argue the existence of one god ruling the universe, from the irregular phenomena observed on land and sea and among the heavenly bodies. "If these had power of their own," he said, "they would have had regular motions, but as they had no regularity they were subservient to the occasional exercise of a higher will." In times of greater scientific knowledge these supposed irregular motions are found to be in accordance with laws considered to be permanent, if not immutable, and the recognition of such tremendous laws gives a higher conception of their maker. The notion that such laws are or can be suspended or violated suggests irresolution and caprice, shocks human reason, and clouds the glory of divinity.

The doctrine attributed to Lot is instructive, because the conception of nature implied in it permeated all the early philosophy. We now define a miracle specifically as a deviation from the laws of nature. But to those for whom nature had no laws, the prime definition as "the wonderful" was alone correct. A supernatural being could do anything whatever in accordance with his arbitrary will, and was expected to act in that manner. Men who were inspired or empowered by the supernatural were also expected, indeed were required, to work wonders. It would hardly be a paradox to assert that only the supernatural was natural, and that only the irregular was regular.

That both the Indians and the Israelites were in this stage of philosophy has been conclusively shown. It is also evident that the principle of ancientism was potent in their religion.

Ancientism, which still has surviving influence, declares the old thought, that of the ancient men, to be always the best. This is false, unless the theory is true that all knowledge comes from revelation, which was given only to the ancient men, who therefore had it in its pure condition. To cling to the old merely because it is old is bad; in fact, is the crudest superstition. Some advocates of the old reject all new thoughts, but the more intelligent of its praisers seek to force a reconciliation between the old thought and the new. What they now believe must be right. What they are not accustomed to is shocking, and therefore wrong. So the old, which was always right, must be distorted so as to comprehend in it the new, which is also right, and whatever there is of the old that can not be managed otherwise must be explained away.

There is an apparent exception in favor of the old thoughts and teachings where there has been a general degradation in culture; then a return to the results of the former and forgotten culture is most desirable. This is illustrated in the revival of the old learning after the dark ages in Europe, when the classic writings as discovered brought fresh illumination to the world. But this was simply a resumption of advance after a check; and the wisdom of the ancients, which has appeared marvelous, owes much of its splendor to the intervening darkness. The process of development, not chronology, makes a proper criterion. Though *antiquitas sæculi juventus mundi*, the archaic is that which relates to the earliest steps of human advance. We have the history of the Israelites for forty centuries; we have that of the Indians for little more than three centuries; and, though the Israelites in recorded times advanced beyond the plane of the Indians, who shall say which of the two peoples is in years the older?

The points before mentioned—that neither the Israelites nor the Indians had any formulated and established faith, and in particular did not believe in a single god, and that they did not have any system of rewards and punishments after death—had important consequences. They were never persecutors for religious opinion. With regard to the Indians that assertion will at once be admitted; with regard to the Israelites it will be disputed by those who take the statements of the compilers of the Old Testament as literally historical.

I have before mentioned one reason, that of the amalgamation of the Israelites with the inhabitants of Canaan, why there could not have been any such fanatic massacre as is narrated. There are other potent reasons. This plane of culture of the Israelites being established, it is proper theoretically to make the deductions belonging to that plane. The Indians carefully concealed their special mystery-daimons. As a matter of fact, the Israelites were generally in accord with their neighbors in religious opinions and practices, so there could have been no antagonism from religious motives. If while worshiping Jahveh they made war for any reason, Jahveh was their reliance, and he conquered or was defeated with them; but they did not make war to force the worship of Jahveh upon others. They would have regarded that as the worst possible policy, as it would have allowed their enemies to pirate upon their divine monopoly which was the essential part of their military equipment.

When men live in the midst of many religions, which imply many revelations, they are charitable to all of them. It is only the isolated and ignorant who are bigoted. A still higher degree of light gained by those who have come out of the caves of superstition will induce them to imitate the decision of the witty sage with regard to ghosts—he had seen so many that he could not believe in any.

When a future state of rewards and punishments, depending upon belief in a particular dogma, has been established, the attitude of believers becomes antagonistic. They maintain that a denial of their belief is disrespect to their god, and they angrily stigmatize such denial as blasphemy or skepticism, or use some other term of vituperation, and they say that their anger is righteous. But it is simply egotistic. The true ground of their hostility to any dissentient opinion is the cloud cast on their title to future happiness. This must be fought as titles are contested in courts of law, or by the last resort of war, or by such persecution as silences the objectors to the title. But as the Israelites claimed no such title, they were not sensitive about its disparagement. In the religious stage described, neither the Indians nor the Israelites sought to make religious proselytes. The noble motive of missionaries is to save souls; but the peoples now compared could not have had, indeed could not have understood, that motive.

At the commencement of this address the rule was laid down that it was essential to omit all reference to revelation as deciding the points discussed. Many points, however, have been touched upon which properly bring to notice the order of the development of revelation in general, without discussion of its decisive authority. This procedure may be submitted to students of anthropology as applicable to all revelations save those which each one individually credits.

It is evident that some practice existed early for which a natural explanation may be given. This practice became a formal custom which, after a time, was considered to be obligatory under the vague but compelling idea that it was "bad luck" not to observe it. Bad luck is necessarily connected with the supernatural. Hence the custom or the congeries of customs became a religion, and that was always supported and explained at a later time by a myth. That was not necessarily an explanation made by imposture or with intent to deceive, but grew from the curiosity of men and their hurry to account for everything. All such myths are declared to be obtained, through revelation, from a power higher than man. The result is, therefore, that revelation, which is the last step in the evolution of religion, is enounced, by antedating, to be the first step. When supposed revelation is once regnant, men cling to it as a refuge from the doubt which must always result from reasoning on subjects which do not admit of demonstration. Such clinging becomes fanatical with most men because they dread as the greatest calamity to be cast into the hands of Giant Doubting, who to them is but another name for Giant Despair. But the path of Doubt leads to the portal of Truth.

It has been no part of my purpose in this address to impugn the character of the books of the Old Testament. On the contrary, I regard that noble work as the most important anthropologic record possessed by man—a work which richly repays the most diligent study. I gladly accept it as a genuine record, and believe that, though it has been colored by time and by the work of designing men, it was never invented. It is sometimes said that persons who are absorbed in scientific studies fear or pretend to scorn the Bible. I neither fear nor scorn it. I admire it, and study it, and gain much from it; but no intelligent person takes as of the same authority all its versions, or, indeed, all the contents of the books which are arbitrarily styled canonical, and about the very names and numbers of which scholars, churches, and sects dispute.

The Hexateuch contains that intrinsic evidence of truth which so impressed the Ojibwa elders, before mentioned, who said that the work was true because they and their fathers "had heard the same stories since the world was new." To those who can read it understandingly it is a true story of a plane of culture.

"Now as to myself I have so described these matters as I have found them and read them; but, if any one is inclined to another opinion about them, let him enjoy his different sentiments without any blame from me."

[*Concluded.*]

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MENTAL AND PHYSICAL TRAINING OF CHILDREN.

By JESSIE ORIANA WALLER.

I.

MY paper is entitled the "Mental and Physical Training of Children," and I shall begin with remarks on physical training, as it is first in natural order, the physical life beginning before the mental. In these days, when there is a great rage for education, a certain top-heaviness has been produced among children, and the good homely helpmate of the mind—the body—is decidedly neglected. It is looked upon as is the dull but sensible wife of some clever man, whose duty is to get through all the home drudgery. She must be invited out with him, but is ignored in society, and is only tolerated on account of her brilliant husband. Now, I consider the body to be just as important as the mind, and that it ought to be treated with just as much respect, especially in these days of intense competition, when, given an equality of brains and education, it is the strong body that tells in the long run, and gives staying power. That alone can help the mind to bear the strain, and anything that can assist our children to bear this daily increasing strain is surely not beneath our notice.

It is really surprising to see the amount of trouble and pains bestowed on the proper housing and feeding of horses and dogs, or other domestic animals, while at the same time comparatively little attention is paid to these matters with regard to the rearing of children. Model stables and model kennels abound, while the model nursery is almost wholly unknown. Warming, ventilation, and aspect are all subjects which are thoroughly considered in the stable, while as regards the nursery they are generally left for chance to decide—though the health of a child is surely more important than that of a horse or a dog. We have all stayed in country houses, where the host has taken us over his beautiful stables fitted with every convenience, and have heard his anxious inquiries as to the health of his favorites, or we have been driven to the model cow-sheds, or kennels, but which of us has been taken over the model nursery?

The men can not be troubled about babies! (though they have no objection to puppies or calves)—they leave all that to the women—and the women, that is to say the mistresses, leave it to the nurses, often entirely ignorant though kindly persons, whose chief recommendation is that they are so fond of children! This would seem a ridiculous state of affairs were it not so lamentable.

Two of the best rooms in the house should be assigned to the children, one for the night the other for the day nursery, but this is by no means often done. In small houses where there is but one spare room, it is of common occurrence to see the largest and sunniest apartment set aside for the visitors, who perhaps occupy it for two months in the year, while the children have to live cramped up in a small, sunless garret.

Sunshine is as necessary to the human being as to the plant; and it is said in confirmation of this that, during the Crimean War, Miss Nightingale nursed the wounded soldiers in a hospital one side of which looked north, the other south, and that she observed that the soldiers lying in the wards with a southern aspect recovered far sooner than their comrades in those on the northern or sunless side. In our climate it is hardly possible to have too much sunshine, and the nurseries should certainly have a southern outlook.

Where there is a large family of children the night nursery is frequently overcrowded, and no regard is paid as to whether there is sufficient cubic space for each person. If there be overcrowding in a hospital, no matter how you ventilate the wards, a high death-rate is the inevitable result, and in the nursery depressed vitality and sickliness as certainly follow upon want of room and air. One thousand cubic feet is not too much to allow for each person.

No nurseries should be papered unless the paper is varnished, for, besides the great risk of putting up an arsenical paper, there is this to be considered—that children are certain to go through some infectious illnesses, after each of which the nurseries must be disinfected and repapered. The best thing for the walls is paint, which can always be washed and disinfected with little trouble, and once on the walls will last for years. Distemper color is the alternative to paint, but with it a dado of paint or varnished paper should be used, as it comes off when touched or rubbed. Distemper should be renewed every year, or after any infectious disease. Nothing that can hold dust should be allowed in the nursery. There should be no carpet nailed down over the floor; it can not be taken up sufficiently often to keep the room sweet, and the accumulation of dust under such a carpet is astonishing. Directly the children begin to romp, the room becomes most unwholesome with its dust-laden atmosphere, flavored by the many mugs of milk that have been spilt, and the many pieces of bread and butter that have been dropped face downward on the carpet during the past year. But I have not space to do more than point out some few things to be avoided, and must as far as possible keep to generalities.

Our lords and masters arrange the diet of dogs and horses with great care; whether the dog should be fed on meat or farinaceous foods, whether the horses should be turned out to grass or fed upon oats or hay, are momentous questions. Any one having the management of horses will notice that a highly fed animal will be able to do a much larger amount of work than one that is stinted and underfed; that a horse fed upon corn is full of spirit, while if turned out to grass it becomes lazy and sleepy, thus proving that food materially affects the spirit and disposition of the animal. And if this be true for one animal, it will be true for all; and it follows that the superior animal—the child—will be equally affected by variations in food, and will require as much care in feeding.

This will hardly be disputed, and yet very rarely is any system followed in feeding children, and if an ordinary fairly educated man were asked to consider the diet of his children, and whether such a diet might not be found which would develop to its utmost the physical powers of each child, he would probably reply that, when he was young, children ate what was put before them, and were none the worse for it. Now, it is impossible to prove that they were none the worse for an indiscriminate diet. No one can say how many slight illnesses might have been avoided, or how many severe ones might have been insignificant, had the child been in a perfectly wholesome state of body, which can only result when it has lived on proper food. Good blood can only be obtained by good food, while weakly or even diseased constitutions may be greatly amended by simple attention to diet.

How little does the ordinary young mother know of her child's requirements! The first baby is generally subjected to a terrible number of experiments: the mother, perhaps, gives it a new food merely because Mrs. So-and-so's baby takes it, having no notion as to whether it is suitable for her own infant's digestion.

I shall now turn to the important subject of clothing. The first object of clothes (at any rate in such a climate as ours) is to keep the body from being chilled during our incessant variations of temperature, and it is well to remark that the prevention of chill has nothing to do with "coddling," which is keeping the body needlessly warm merely because warmth is pleasant. Clothes should be light, and of woolen material, and should in no way impede free movement.

It may seem superfluous to state facts which are no doubt obvious to every one, but it is not of common occurrence to see a child dressed in a reasonable manner, especially when it is very young. Although I own that children are now more sensibly clothed than was the case thirty years ago, it is still common to see an infant, who can take no exercise to warm himself, wearing a low-necked, short-sleeved, short-coated dress in the coldest weather. The two parts of the body—viz., the upper portion of the chest and the lower portion of the abdomen—which it is most important to keep from variations of temperature, are exposed, and the child is rendered liable to colds, coughs, and lung diseases on the one hand, and bowel complaint on the other. What little there is of the dress is chiefly composed of open work and embroidery, so that there is about as much warmth in it as in a wire sieve, and the socks accompanying such a dress are of cold white cotton, exposing a cruel length of blue and red leg. I can not see the beauty of a pair of livid blue legs, and would much rather behold them comfortably clad in a pair of stockings. If the beauty lie in the shape of the leg, that shape will be displayed to as much advantage in a pair of stockings; if it lie in the coloring of the flesh, beautiful coloring will not be obtained by leaving the leg bare; and from the artistic point of view, a blue *or* red stocking is infinitely preferable to a blue *and* red leg.

There is a comfortable supposition that children do not feel cold so much as grown-up persons, but this is not true. It is a fact that not only has a child less power of generating heat than the adult, but that it has also a much larger surface in proportion to the mass of its body, and will consequently be far more susceptible to cold. Cold feet cause a great amount of indigestion, and exposure of the large blood-vessels of the thigh during childhood frequently sows the seeds of kidney diseases, to develop in after-life.

Insufficient clothing and much exposure to cold have the effect of making a child appear torpid, benumbed bodily and mentally, and it stands to reason that if its small powers are entirely consumed in merely keeping alive and fairly warm, no vital energy will be left for anything else, and a child has more to do than the adult: it has not only to repair waste, but it has to grow and make new tissue. But it must not be thought that I am a friend to coddling—on the contrary, I believe that, once let a child be clothed from head to foot in wool, it may go out in almost any weather; and I am sure that most nurseries would be healthier by being kept cooler. I know that I shall have the cottage children held up to me as examples of the hardening system; I shall be told to observe their rosy cheeks, their sturdy limbs. As a matter of fact, I don't much believe in them. Our hospitals are full of cottage children—poor little creatures, mostly suffering from exposure and bad feeding! The reason that the strongest live is that they live in the open air, and it is a common thing to hear a poor woman say in response to your inquiry as to her children: "I've got five, ma'am; I've buried four." The largest mortality occurs in children under one year old; and in Russia, I believe, chiefly owing to the intense cold in winter, the death-rate among children is something appalling. In England infant mortality is greatest in hot summer and autumn—from diarrhœa—largely owing to badness of milk kept in dirty vessels.

In concluding this part of my paper, I may remark that a mother should remember the old proverb that prevention is better than cure, and that, by daily careful supervision of her child, she may save him from much that the unfortunate child of a careless mother has to endure, and may also console herself, when unavoidable illness comes, that she has done all that lies in her power to provide her child with health and strength to resist disease.

II.

As soon as a child is old enough to develop a will of its own, the first thing it does is to try and get its own way, and one of the earliest lessons it has to learn is that it can only have its own way when it is compatible with the comfort and rights of others; and even a mere baby will soon find out how far it may encroach on the kindness or weakness of those around it.

As we are none of us born models of virtuous behavior, some kind of punishment must necessarily be used now and then in the nursery; but, as far as is possible, the child should be made to feel that the punishment is the natural result of his bad action, and not the mere venting of anger and annoyance on the part of the parent or nurse. If a child once finds out that certain actions always entail unpleasant consequences, he will no more think of committing them than he would think of putting his hands in the fire, which, he has early learned, has an unpleasant habit of burning. There are no better philosophers than children, who always resign themselves to the inevitable; but let the children be certain that it *is* the inevitable—let the child find out that bad behavior in the drawing-room means instant banishment to the nursery; that if he knocks his brother with a stick the result is "*no sticks*"; that if he refuses to put away his toys one night, he must manage without toys the next night, and so on.

If the mother merely talks at the child, and says, "How often must I tell you not to do so?" or, "I shall send you up-stairs," the child soon perceives that, after all, this entails no consequences, and he very wisely acts accordingly. On the other hand, nothing should be denied to a child without some reason. A great many mothers, and most nurses, bring up children on the principle contained in "Punch's" remark, so delightfully illustrated by Du Maurier: "Maud, go and see what Baby is doing, and tell him he mustn't."

With regard to corporal punishment, I think it wholly unnecessary. Even those who assert that it is good for children can not deny that it is bad for parents. No one is virtuous enough to be judge, jury, and executioner in one. And if it is harmful for a mother to treat her child like an animal, it must no less harm the child to be treated as one, and to be governed through the feelings of pain and fear, instead of the higher ones of reason and affection. But here I can not do better than quote a few passages from Locke's "Essay on Education," which I think very wise:

> The usual lazy and short way by chastisement with the rod, the only instrument of government that tutors generally know, is the most unfit of any to be used in education. For from what other motive but of sensual pleasure or pain does a child act who drudges at his book against his inclinations, or abstains from eating unwholesome fruit that he takes pleasure in only out of fear of whipping, and what is it to govern his actions and direct his conduct by such motives as these? What is it, I say, but to cherish that principle in him which it is our business to root out and destroy? And therefore I can not think any correction useful to a child where the shame of suffering for having done amiss does not work more upon him than the pain.

And again:

> I am very apt to think that great severity of punishment does but very little good, nay, great harm, in education, and I believe it will be found those children which have been most chastised seldom make the best men.

> If the mind be curbed and humbled too much in children, if their spirits be abased and broken much by too strict a hand over them, they lose all their vigor and industry. For extravagant young fellows that have liveliness and spirit come sometimes to be set right, and so make able and great men. But dejected minds, timorous and tame, and low spirits, are hardly ever to be raised, and very seldom attain to anything.

Again, when a child does well, Locke advises his father and mother to show pleasure, and, upon his doing ill, to show a cold, neglectful countenance, and this, he says, "if constantly observed, I doubt not but will of itself work more than threats or blows, which lose their force when once grown common, and are of no use when shame does not attend them." With regard to the early teaching of children, it should be remembered that a young child is always learning, and therefore parents should not be in too great a hurry to begin that branch of education popularly known as "lessons"; and lessons themselves must not be looked upon as an end, but as a means, or as tools put into the hands of a child to enable him to shape his own life and discover its uses and beauty.

We do not want to manufacture little prigs, who have swallowed a mass of facts never to be digested, but we want children who can take an intelligent interest in all that is going on around them. They will learn much if their mothers will only take the trouble to answer questions in an intelligent manner: it is either laziness or stupidity to repulse a child with "Don't ask questions."

A mother who conscientiously answers questions will find that she too has profited as well as her children, and if there are some questions the right answers to which it would be impossible for children to understand, let them be told so honestly and not put off with evasive answers. Nothing is better for young children than to be sent to a good Kindergarten: they learn to be obedient when they find obedience is expected as a matter of course; they learn to be observant, which is of great use to them in after-life; and they are made to take a pleasure in all they do, as all they learn is made interesting to them. The Kindergarten principles may, however, be carried out in all home teaching, when pleasure in learning will be found one of the greatest aids to mental digestion.

I should begin the teaching of a child as a favor, not as a task; if he is inattentive, I should by no means insist upon the lesson being done, and so give it the air of a task. It is far better to say: "I really can not waste my time in teaching you. I have other matters to do, and if you can not give me a little attention you may go away." With the natural perversity of human nature, the child immediately becomes anxious to learn, and feels at once that you are doing him a favor, not he, you. If a child seems dull, never force it to learn. If the dullness proceeds from delicacy, every effort should be made to strengthen the body, and definite teaching should begin later than with a robust child. It is most foolish to cram the head of a backward child with phrases it can not understand—at most it can but learn parrot-fashion, and such a proceeding is about as senseless as loading a delicate stomach with indigestible food. If a child has an appetite for its bodily food, it can digest, and the same rule holds good for mental food. There is no use in cramming it down if the appetite for knowledge be not there.

All teaching should proceed from the concrete to the abstract, though the reverse method is generally employed. Arithmetic, for instance, should at first be taught from objects, and not by names and figures which are mere symbols and abstractions, and most difficult for the minds of children to grasp. The relative value of different kinds of money may be easily learned by quite young children, merely by letting them play at shop with real money. At the same time they are unconsciously learning both addition and subtraction. Weights and measures should be learned in the same way, and they will be far better impressed on the memory than by merely learning the tables of weights and measures in an arithmetic book.

Again, with languages—rules of grammar should be learned last of all; a language is formed long before any rules for speaking it are formulated. The rules of grammar are only the recorded observations of what I may call the habits of a language. Every child should learn a new language as it learns its own, by talking it, looking at picture books and learning nursery rhymes, and the language will have some chance of developing naturally and easily, and of being retained for use in after-life. As languages are usually taught in schools, they are of no value beyond that of mental gymnastics, and when the school life is over all the rules and exercises, learned with so much weariness and disgust, slip from the memory, from having made no impression on the mind.

If the child has a natural bent in some particular direction, this should be encouraged as early as possible. I think, as a rule, children are taught far too many things. Who does not know of girls who, with no ear for music, are forced daily to undergo the drudgery of practicing, merely because it is the proper thing for girls to play, at any rate a little? Many persons will be terribly alarmed at the suggestion that science is one of those things all children should be taught. The word science suggests to them all that is dry, cold, difficult, and unromantic—why, I can not tell, for the word itself only means knowledge, and children find anything acceptable and interesting that will answer their numerous questions concerning all around them, and far from being dry and unromantic. "Science," to use the words of Mr. Herbert Spencer, "opens up realms of poetry where to the unscientific all is a blank."

Science properly taught is most valuable to children, in that it encourages a spirit of inquiry and love of truth, and trains them in habits of accurate observance of all around them, all of which qualities must surely be of use to them. These conclusions will not, perhaps, be acceptable to those persons to whom science is represented merely by the learning by heart of a collection of arid statements: such as the distance from here to the moon—the rate at which the earth revolves on its own axis—and so on. I should certainly advise them *not* to teach their children science of this description.

Before ending my paper, I should like to say a few words with regard to what I think a great evil in the education of girls. At an age of rapid growth, a girl's health is sometimes ruined for life by the system of brain-forcing to which she is subjected. In many cases she has to work eight hours a day, which is the average number of working hours of a grown man. Examinations follow one after another, there is no time to attend to the development of the body, at the most one hour in the twenty-four is given up to a mild walk; and the continuous sitting in a stuffy room, stooping over books narrows the chest, and spoils the eye-sight; at the age of eighteen a pale, anæmic young lady emerges from the school-room, doubtless stocked with knowledge, but also with headaches and backaches enough to spoil the rest of her life.

When one considers the extraordinary rate at which a girl of fourteen will grow, and how much of her forces must be consumed in the mere act of growing, surely it seems more reasonable to lighten her work than to increase it. Such a girl should only be allowed to work in the mornings, when she is freshest, and the rest of the day should be devoted to the open air, and development of her body by healthy outdoor games. Above all, even if she has work in the afternoon—and some time must, I suppose, be allowed for preparation—no mental work of any kind should be allowed after 5 P.M. After a long day at school, many a time does the tired child return with a quantity of exercises, etc., to be prepared for the morrow, all of which must be done in the evening, and it stands to reason that it must be highly prejudicial to the brain to be taxed at a time when it is fatigued, and the physical powers of the child are at a low ebb.

In a paper entitled "Home Lessons after School Hours," sent to me by my friend Sir Joseph Fayrer, and read by him at a conference at the Health Exhibition, he points out the dangers attending the cramming system, and instances many cases of brain disease resulting from it.

In conclusion, let me say that moral development can not be too early or carefully attended to. Morals in a child are in a very rudimentary condition, and much depends on the mother as to whether they are to develop and give strength to the character, or whether they are to wither away, like unused organs of the body. Truthfulness, courage, and unselfishness are blossoms of character growing from but small seeds; let them be nourished in the warmth and sunshine of love and sympathy, and watchfully protected from choking weeds, and at last will come the crowning of a fine character, without which all the book-learning in the world is but a parrot's jargon.—*Nineteenth Century.*

THE STRUGGLE OF SEA AND LAND.

By Dr. VINZENZ HILBER, of Graz.

WE stand on a bluff at the sea-shore. The surf is undermining it. That deep cutting into the bank is its work. An overhanging mass of earth is thrown down and becomes the toy of the waves, which reduce it to gravel. This in its turn becomes ammunition to be hurled against the shore. Wherever this process is going on, the land falls back before the advancing sea, and considerable results are evident in a short time. The Island of Heligoland has been reduced, within a thousand years, from a considerable island to a mere rock. The strings of rocky islands along many coasts are remnants of destroyed shore-land. Thus the land yields with hardly a struggle to the supremacy of the sea. Loose alluvial terrains give way in a body. The Zuyder Zee so came into being five hundred years ago, and Holland, part of which is below the level of the sea, would have been likewise overflown if it had not been defended by artificial dikes. Subsidences of ground have also been sometimes observed during earthquakes.

In other places the sea gives way. Rivers carry out masses of detritus and deposit them along the shores, causing the land to advance. By the operation of this process Roman ports on the eastern coast of Italy have been left away inland, and whole alluvial districts of the upper Italian plain have been wrested from the sea.

No doubt a very long time is required for important changes in the sea-lines to be produced by these processes; hence we must widen our view if we would find a solution of the problems which the history of the primitive seas offers us.

When the Alpine traveler finds sea-shells included in the rocks on high peaks, he says that the strata of the mountain are ocean deposits. In the great foldings of the rocks which he can follow along the naked cliffs, he recognizes the results of mighty movements which the strata have undergone since they were formed, and will correctly ascribe their elevation to the same movements. The mountain has been produced through a doubling up caused by a sidewise pressure. If he turns his steps to the adjacent lowlands, he will make the same observation in horizontal strata. He now has his choice whether to believe in an elevation of a large part of the earth's crust, or in a sinking of the level of the sea since the crust was formed. One of the most debated questions of geology turns on this point.

The successive layers of the earth's crust have sometimes been compared to the leaves of a book. We read in them a long passage in the earth's history written by the scribe Nature herself while the events were happening, and therefore even more trustworthy than the sources of ordinary history. Yet many pages of the book are obscure, and those of the first part are still waiting to be deciphered; for, in the sparkling leaves of the archaic crystalline rocks, the letters that should give us knowledge of the beginnings of life on the earth seem to have been washed out. The first volume, telling of the Palæozoic age, makes us acquainted with a lower fauna, principally marine, from which only the vertebrates are absent. Then cartilaginous fishes appear in the Silurian and Devonian, and land-inhabiting vertebrates, amphibia, and reptiles in the Carboniferous and Permian. The development of life goes on in the Mesozoic epoch. The oldest and lowest organized mammals, the marsupials, meet us in the upper Trias. The Jurassic gives us the first birds, curious creatures with teeth in their bills and lizards' tails bearing feathers. Two specimens have been found, in the *Archæopteryx*, of the transition form between the reptile and the bird. The Cretaceous furnishes the first bony fish and new toothed birds, the odontornithides. The Cenozoic age, the fourth and last volume of the great book, exhibits another advance in the development of animal life; and in the Tertiary the forerunners of the present mammals, and in the diluvial, man, appear. A similar process of development from lower to higher forms is shown in the vegetable world.

The story of this gradual rise of more and more highly organized beings is certainly the most important content of those stone books. But, besides that, they record that the firm lands arose out of the floods, that the sea washed over the land, left it, and covered it again, while the mass of the land constantly grew. The pages that sketch the covering of a stretch of earth by the sea are fully written up; but the periods of dry land are more frequently made known by a gap than by a continuance of the relation; and, in the latter case, the terrestrial deposits are only present when the spot has been covered by a river or a lake.

According to the best established and prevailing views, the great sea-beds, the deep basins, are the original features of the "face of the earth." They are the first depressions that were made after the planet's surface was solidified and its structure began to shrink from cooling. These depressions have probably been increasing vertically through all the geological ages, and therein lies the cause of the constant increase of the land to the present time. But the constancy of this increase is a fact only as a whole; for there have been times when the sea rose over the shore and overflowed a large part of the land. The last great transgression of this kind occurred at the beginning of the Miocene Tertiary, when extensive tracts of the Old World were covered with water. Parts of Italy, Portugal, southern France, northern Switzerland, southern and northern Germany, the Vienna basin, and the Hungarian plain, and of the lowlands of eastern Europe and the Black Sea region away into the interior of Asia to Persia, with the plains of North Africa still bear the marine deposits of that period, with the remains of organisms, mostly of extinct species, that inhabited the adjoining seas. The waters retired to their beds during the Pliocene, and the present boundary-lines of the land regions, aside from a few erosions, were shaped during the same period. Similar processes took place repeatedly in the earlier periods of the earth's growth, and to them are ascribed most of the changes that have taken place in the species of animals and plants; for these encroachments of the sea forced the living world into a narrower space, and entailed a fierce struggle for existence, in which the less valiant species succumbed. The retreat of the sea again permitted a fruitful development of life and the origination of new species.

An important circumstance has been brought to light in the investigation of the fluctuations of the ocean. The continents have been overflowed several times. Suess, who has made the most thorough study of the subject, has recognized six principal periods of submersion, and as many of dryness. But no indubitably deep-sea deposits later than the Silurian are to be found on the present continents. The great sea-beds are primitive; and primitive likewise are the socles of the continents, standing as equally sturdy champions with the briny flood, sometimes in the alternations of the contest lying under it, overcome by the sea, at other times shaking it off and sending it back within its lines.

The cause of these processes is still awaiting explanation. Celsius and Linnæus, who observed the gain of land on the Baltic coast during the last century, expressed the opinion that the sea was retreating. This view was contested at the beginning of the present century by Leopold von Buch, who thought that Scandinavia was rising. Lyell and Darwin advanced the theory of the rising and sinking of continents, and this solution of the problem has not been contradicted till very recently. There is a kind of suggestion with which great men, to whose minds the world pays deference, inspire their contemporaries when they give any view the weight of their approval, which is at the same time detrimental to progress in science. In this way many an error has been generally accepted without further proof.

Suess does not ask for an unjudicial acceptance of his theory, but has published the whole course of his investigations, with his proofs, in a great work, the "Antlitz der Erde" ("The Face of the Earth"), in which he has examined the signs of changes in the level of the ocean, so far as they have been observed in all known parts of the earth and through all the geological periods. His exposition points to a synchronism of overflows and uncoverings of the land over extensive regions. This result has impelled him to oppose the prevailing doctrine of upheavals and depressions of the land. Aside from the fact that the supposed elevation of the continents is problematical in itself, such movements could not go on over the whole earth at the same time and in the same direction. Changes in the level of the waters, on the other hand, would be of the general character which the survey of the phenomena indicates, for a free rising of the water, even under local influences, would at once make itself felt over the whole surface of the earth.

Suess's studies of the causes of the rising and falling of the waters brought him to the following conclusions: The ocean beds were produced by the sinking of those parts of the earth's surface that correspond with them. The uneven shrinking of the globe is a consequence of its continuous cooling. Every new subsidence of the sea-bottom causes a falling of the water. Elevations of the ground take place too. The bottom of the ocean is incessantly receiving detritus from the overflowed land, of which the water brings down as much as it can hold; this tends to raise the level of the ocean. Yet Suess concludes that these processes are not adequate to explain the full measure of the primitive movements, and reserves judgment on that point.

The present author has gone further into this subject, in an article in the "Zeitschrift für wissenschaftliche Geographie," although he has not concealed the existing difficulty. Unfortunately, Suess's deductions were not before him when he prepared his paper. That essay, building in part on similar researches, accepts contraction as the sufficient cause for the fluctuations of the sea. According to the now prevailing views, which have, however, been very recently contradicted by investigators of repute, the constant loss of heat from the interior of the earth produces a steady shrinkage of the globe. From time to time the tensions in the outer arches of the earth are relaxed, and the crust sinks. In that case, three views are conceivable respecting the relations of land and sea: either both parts sink alike, or the land sinks more than the sea, or the sea than the land. In the first case, the rise of the sea will be only that caused by the contraction of its bed, which, being dependent on the slighter contraction of the surface of the globe, is of relatively little importance; in the second case, the sea would spread over the lower lands, rising to appearance, while in fact its level has diminished on account of the wider diffusion of its waters; or, in the third case, the sea would retire on account of the falling of its level.

These things alone could hardly have produced the observed results, had there not been important circumstances associated with them which in times of quiet worked in their favor. The land is being uninterruptedly swept off, and is gradually as a whole becoming lower and lower from the top. The rock falls from the heights, the brooks and rivers take fragments in their course and drag the chips of weathering and of their own planing-work into the sea. The land is reduced by denudation, the sea rises by the action of the deposits on its bottom. Extensive lowlands are at last formed as the result of the washings, so that large districts may be put under water by slight shrinkings of the land. When these are overflowed by the sea, the deposits rise on its bottom, stratum by stratum, till, after a long time, they nearly reach the level of the water. Then a slight sinking of the sea-bottom suffices to reduce the water to its old level; and the alternation of a washing away of the soil and the conversion of the overflowed territory into dry land begins anew.—*Translated for the Popular Science Monthly from Das Ausland.*

THE ROYAL SOCIETY OF ENGLAND.

By Dr. WILLIAM C. CAHALL.

THAT "wonderful pacifick year 1660" witnessed the restoration of the house of Stuart and the organization of the Royal Society.

After twenty years of civil wars, Cromwell, and Puritanism, the English people, with the surfeit which invariably follows the prolonged discussion of one idea, turned with avidity to the gay court which Charles II brought with him into Whitehall. Peace came, commerce flowed on undisturbed, and from the strictest religion the national pendulum swung to license, skepticism, and debauchery.

Fortunately, it was but a part of England which fell into these excesses. There was an element which likewise turned from the heated discussions of theology, but, more wisely, sought the serene companionship of Nature as the restful change.

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Sir Robert Moray, the first president, brought in word from the court that "the king had been acquainted with the design of the meeting. And he did well approve of it, and would be ready too early or carefully attended to. Morals in a child are in a very rudimentary condition, and much depends on the mother as to whether they are to develop and give strength to the character, or whether they are to wither away, like unused organs of the body. Truthfulness, courage, and unselfishness are blossoms of character growing from but small seeds; let them be nourished in the warmth and sunshine of love and sympathy, and watchfully protected from choking weeds, and at last will come the crowning of a fine character, without which all the book-learning in the world is but a parrot's jargon.—*Nineteenth Century.*

THE STRUGGLE OF SEA AND LAND.

By Dr. VINZENZ HILBER, of Graz.

WE stand on a bluff at the sea-shore. The surf is undermining it. That deep cutting into the bank is its work. An overhanging mass of earth is thrown down and becomes the toy of the waves, which reduce it to gravel. This in its turn becomes ammunition to be hurled against the shore. Wherever this process is going on, the land falls back before the advancing sea, and considerable results are evident in a short time. The Island of Heligoland has been reduced, within a thousand years, from a considerable island to a mere rock. The strings of rocky islands along many coasts are remnants of destroyed shore-land. Thus the land yields with hardly a struggle to the supremacy of the sea. Loose alluvial terrains give way in a body. The Zuyder Zee so came into being five hundred years ago, and Holland, part of which is below the level of the sea, would have been likewise overflown if it had not been defended by artificial dikes. Subsidences of ground have also been sometimes observed during earthquakes.

In other places the sea gives way. Rivers carry out masses of detritus and deposit them along the shores, causing the land to advance. By the operation of this process Roman ports on the eastern coast of Italy have been left away inland, and whole alluvial districts of the upper Italian plain have been wrested from the sea.

No doubt a very long time is required for important changes in the sea-lines to be produced by these processes; hence we must widen our view if we would find a solution of the problems which the history of the primitive seas offers us.

When the Alpine traveler finds sea-shells included in the rocks on high peaks, he says that the strata of the mountain are ocean deposits. In the great foldings of the rocks which he can follow along the naked cliffs, he recognizes the results of mighty movements which the strata have undergone since they were formed, and will correctly ascribe their elevation to the same movements. The mountain has been produced through a doubling up caused by a sidewise pressure. If he turns his steps to the adjacent lowlands, he will make the same observation in horizontal strata. He now has his choice whether to believe in an elevation of a large part of the earth's crust, or in a sinking of the level of the sea since the crust was formed. One of the most debated questions of geology turns on this point.

The successive layers of the earth's crust have sometimes been compared to the leaves of a book. We read in them a long passage in the earth's history written by the scribe Nature herself while the events were happening, and therefore even more trustworthy than the sources of ordinary history. Yet many pages of the book are obscure, and those of the first part are still waiting to be deciphered; for, in the sparkling leaves of the archaic crystalline rocks, the letters that should give us knowledge of the beginnings of life on the earth seem to have been washed out. The first volume, telling of the Palæozoic age, makes us acquainted with a lower fauna, principally marine, from which only the vertebrates are absent. Then cartilaginous fishes appear in the Silurian and Devonian, and land-inhabiting vertebrates, amphibia, and reptiles in the Carboniferous and Permian. The development of life goes on in the Mesozoic epoch. The oldest and lowest organized mammals, the marsupials, meet us in the upper Trias. The Jurassic gives us the first birds, curious creatures with teeth in their bills and lizards' tails bearing feathers. Two specimens have been found, in the *Archæopteryx*, of the transition form between the reptile and the bird. The Cretaceous furnishes the first bony fish and new toothed birds, the odontornithides. The Cenozoic age, the fourth and last volume of the great book, exhibits another advance in the development of animal life; and in the Tertiary the forerunners of the present mammals, and in the diluvial, man, appear. A similar process of development from lower to higher forms is shown in the vegetable world.

The story of this gradual rise of more and more highly organized beings is certainly the most important content of those stone books. But, besides that, they record that the firm lands arose out of the floods, that the sea washed over the land, left it, and covered it again, while the mass of the land constantly grew. The pages that sketch the covering of a stretch of earth by the sea are fully written up; but the periods of dry land are more frequently made known by a gap than by a continuance of the relation; and, in the latter case, the terrestrial deposits are only present when the spot has been covered by a river or a lake.

According to the best established and prevailing views, the great sea-beds, the deep basins, are the original features of the "face of the earth." They are the first depressions that were made after the planet's surface was solidified and its structure began to shrink from cooling. These depressions have probably been increasing vertically through all the geological ages, and therein lies the cause of the constant increase of the land to the present time. But the constancy of this increase is a fact only as a whole; for there have been times when the sea rose over the shore and overflowed a large part of the land. The last great transgression of this kind occurred at the beginning of the Miocene Tertiary, when extensive tracts of the Old World were covered with water. Parts of Italy, Portugal, southern France, northern Switzerland, southern and northern Germany, the Vienna basin, and the Hungarian plain, and of the lowlands of eastern Europe and the Black Sea region away into the interior of Asia to Persia, with the plains of North Africa still bear the marine deposits of that period, with the remains of organisms, mostly of extinct species, that inhabited the adjoining seas. The waters retired to their beds during the Pliocene, and the present boundary-lines of the land regions, aside from a few erosions, were shaped during the same period. Similar processes took place repeatedly in the earlier periods of the earth's growth, and to them are ascribed most of the changes that have taken place in the species of animals and plants; for these encroachments of the sea forced the living world into a narrower space, and entailed a fierce struggle for existence, in which the less valiant species succumbed. The retreat of the sea again permitted a fruitful development of life and the origination of new species.

An important circumstance has been brought to light in the investigation of the fluctuations of the ocean. The continents have been overflowed several times. Suess, who has made the most thorough study of the subject, has recognized six principal periods of submersion, and as many of dryness. But no indubitably deep-sea deposits later than the Silurian are to be found on the present continents. The great sea-beds are primitive; and primitive likewise are the socles of the continents, standing as equally sturdy champions with the briny flood, sometimes in the alternations of the contest lying under it, overcome by the sea, at other times shaking it off and sending it back within its lines.

The cause of these processes is still awaiting explanation. Celsius and Linnæus, who observed the gain of land on the Baltic coast during the last century, expressed the opinion that the sea was retreating. This view was contested at the beginning of the present century by Leopold von Buch, who thought that Scandinavia was rising. Lyell and Darwin advanced the theory of the rising and sinking of continents, and this solution of the problem has not been contradicted till very recently. There is a kind of suggestion with which great men, to whose minds the world pays deference, inspire their contemporaries when they give any view the weight of their approval, which is at the same time detrimental to progress in science. In this way many an error has been generally accepted without further proof.

Suess does not ask for an unjudicial acceptance of his theory, but has published the whole course of his investigations, with his proofs, in a great work, the "Antlitz der Erde" ("The Face of the Earth"), in which he has examined the signs of changes in the level of the ocean, so far as they have been observed in all known parts of the earth and through all the geological periods. His exposition points to a synchronism of overflows and uncoverings of the land over extensive regions. This result has impelled him to oppose the prevailing doctrine of upheavals and depressions of the land. Aside from the fact that the supposed elevation of the continents is problematical in itself, such movements could not go on over the whole earth at the same time and in the same direction. Changes in the level of the waters, on the other hand, would be of the general character which the survey of the phenomena indicates, for a free rising of the water, even under local influences, would at once make itself felt over the whole surface of the earth.

Suess's studies of the causes of the rising and falling of the waters brought him to the following conclusions: The ocean beds were produced by the sinking of those parts of the earth's surface that correspond with them. The uneven shrinking of the globe is a consequence of its continuous cooling. Every new subsidence of the sea-bottom causes a falling of the water. Elevations of the ground take place too. The bottom of the ocean is incessantly receiving detritus from the overflowed land, of which the water brings down as much as it can hold; this tends to raise the level of the ocean. Yet Suess concludes that these processes are not adequate to explain the full measure of the primitive movements, and reserves judgment on that point.

The present author has gone further into this subject, in an article in the "Zeitschrift für wissenschaftliche Geographie," although he has not concealed the existing difficulty. Unfortunately, Suess's deductions were not before him when he prepared his paper. That essay, building in part on similar researches, accepts contraction as the sufficient cause for the fluctuations of the sea. According to the now prevailing views, which have, however, been very recently contradicted by investigators of repute, the constant loss of heat from the interior of the earth produces a steady shrinkage of the globe. From time to time the tensions in the outer arches of the earth are relaxed, and the crust sinks. In that case, three views are conceivable respecting the relations of land and sea: either both parts sink alike, or the land sinks more than the sea, or the sea than the land. In the first case, the rise of the sea will be only that caused by the contraction of its bed, which, being dependent on the slighter contraction of the surface of the globe, is of relatively little importance; in the second case, the sea would spread over the lower lands, rising to appearance, while in fact its level has diminished on account of the wider diffusion of its waters; or, in the third case, the sea would retire on account of the falling of its level.

These things alone could hardly have produced the observed results, had there not been important circumstances associated with them which in times of quiet worked in their favor. The land is being uninterruptedly swept off, and is gradually as a whole becoming lower and lower from the top. The rock falls from the heights, the brooks and rivers take fragments in their course and drag the chips of weathering and of their own planing-work into the sea. The land is reduced by denudation, the sea rises by the action of the deposits on its bottom. Extensive lowlands are at last formed as the result of the washings, so that large districts may be put under water by slight shrinkings of the land. When these are overflowed by the sea, the deposits rise on its bottom, stratum by stratum, till, after a long time, they nearly reach the level of the water. Then a slight sinking of the sea-bottom suffices to reduce the water to its old level; and the alternation of a washing away of the soil and the conversion of the overflowed territory into dry land begins anew.—*Translated for the Popular Science Monthly from Das Ausland.*

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THE ROYAL SOCIETY OF ENGLAND.

By Dr. WILLIAM C. CAHALL.

THAT "wonderful pacifick year 1660" witnessed the restoration of the house of Stuart and the organization of the Royal Society.

After twenty years of civil wars, Cromwell, and Puritanism, the English people, with the surfeit which invariably follows the prolonged discussion of one idea, turned with avidity to the gay court which Charles II brought with him into Whitehall. Peace came, commerce flowed on undisturbed, and from the strictest religion the national pendulum swung to license, skepticism, and debauchery.

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"There arose at this time," says Dr. Whewell, "a group of philosophers, who began to knock at the door where truth was to be found, although it was left for Newton to force it open. These were the founders of the Royal Society."

But to Lord Bacon, who died but thirty-six years before the incorporation of the society, is due the first impulse in England to the proper study of nature. Indeed, some such an institution as the Royal Society, for the study of the sciences, was in his mind when he wrote his philosophical romance, the "New Atlantis." What he did not live to form, his disciples realized.

Dr. Wallis, in his diary of 1696–'97, says: "About the year 1645, while I lived in London (at a time when, by our civil wars, academical studies were much interrupted in both our universities), besides the conversation of diverse eminent divines, as to matters theological, I had the opportunity of being acquainted with diverse worthy persons, inquisitive into natural philosophy and other parts of human learning, and particularly of what had been called the *New Philosophy* or *Experimental Philosophy*. . . . Our business (at these meetings, held at Gresham College) was (precluding matters of theology and statecraft) to discourse and consider of *Philosophical Enquiries*, and such as related thereto: as *Physick, Anatomy, Geometry, Astronomy, Navigation, Staticks, Magneticks, Chemicks, Mechanicks*, and *Natural Experiments*. We then discoursed of the circulation of the blood, the valves of the veins, the venæ lacteæ, the lymphatick vessels, the Copernican hypothesis, the nature of comets and new stars, the satellites of Jupiter, the oval shape of Saturn, the spots in the sun, and its turning on its own axis, the inequalities and selenography of the moon, the several phases of Venus and Mercury, the improvement of telescopes, and grinding of glasses for that purpose, the weight of air, the possibility or impossibility of vacuities, and nature's abhorrence thereof, the Torricellian experiment in quicksilver, the descent of bodies and the degree of acceleration therein, and diverse other things of like nature."

These meetings were continued at Gresham College and at Oxford, whither many went with Charles I, as frequently as the exigencies of war permitted; but, with Charles II firmly seated on the throne, the fugitives returned to London, where, in 1660, the society was formally instituted, and application was made to the king to give it a corporate being and name by a royal charter.

Sir Robert Moray, the first president, brought in word from the court that "the king had been acquainted with the design of the meeting. And he did well approve of it, and would be ready to give encouragement to it." The royal patron fulfilled his promise.

The charter of incorporation passed the great seal on the 15th of July, 1662, and was read on the 13th of August following.

Evelyn's "Diary" of this date contains this passage: "Our charter being now passed under the broad seal, constituting us a corporation, the name of Royal Society, for the improvement of natural knowledge, was this day read; and was all that was done this afternoon, being very long."

Charles affected chemistry and navigation, and, when he grew tired of his wine and his mistresses, would resort to his laboratory, and as the young rakes, who circled about him, imitated the royal exemplar's dissipations, so they frequented the scientific lectures and tried to look wise. But even Charles and his fops could not, by their attention, harm the growing sciences in the estimation of good and true men. The reason for this may be found in the recognition of the need of such a society, and the character of the men constituting it. The fame of such men as Sir Robert Moray, Boyle, Evelyn, Pepys, Wallis, Hooke, and Wren, who were among the incorporators, continues lively to this day. It may not be, as has been said, that the incorporation of the Royal Society was the only wise act of Charles II, yet it has proved itself, without a doubt, his wisest act.

It was high time that England was bestirring herself, for on every side were evidences of the pressing need of some such instigating and conserving force as the Royal Society soon became. Every intellectual center of Italy had its Academy of Science, and France already had her society for the study of literature. The origin of learned societies appears to take the same course as the order of succession of the universities. As the first university arose in Italy, so arose the first academy; then comes France, with her University of Paris and the French Academy; later, England follows close upon the heels of France, with her universities at Oxford and Cambridge, and her Royal Society. By the lapsing of the Academy del Cimento of Florence, and other Italian academies, the Royal Society of England enjoys the honor of being the oldest in consecutive history of any society in Europe which was established for the investigation and advancement of science.

There is no better illustration of the true scientific spirit of inquiry which the Royal Society at once set on foot throughout England, than its influence upon the popular superstitions of the day. The popular belief in witchcraft had, during the sixteenth and seventeenth centuries, reached the height of its frenzy.

In Germany the number of persecutions was enormous. A twentieth part of the entire population of the small district of

Lindheim fell victims in four years. In the district of Como, Switzerland, one thousand were burned in one year (1524). In France the destruction of life was equally frightful. Witch-persecutions in England came on later, but were equally ferocious.

James I wrote a treatise on "Demonology," and during the Long Parliament three thousand persons were executed by legal processes alone, not counting the victims by mobs, as a result of this witch-mania.

But, according to Hutchison, chaplain to George I, who wrote upon witchcraft, "there were but two witches executed in England after the Royal Society published their 'Transactions,' and one of these was in the year after their first publication."

And Sir Walter Scott, in his letters on "Demonology and Witchcraft," expresses his belief that the Royal Society "tended greatly to destroy the belief in witchcraft and superstition generally."

What a comment upon the value of scientific studies!

Touching for king's-evil or scrofula, which was long rife in England, was another but more harmless superstition which the Royal Society was active in destroying. Imagine the feelings of the fastidious Charles, under such ordeals as the one related of him by Aubrey in his "Miscellanies": "Arise Evans had a fungous nose, and said it was revealed to him that the king's hand would cure him: and at the first coming of King Charles II in St. James's Park he kissed the king's hand and rubbed his nose with it, which disturbed the king, but cured him."

Even within the Royal Society itself there was a lack of precision in scientific investigation. Upon the same evening that Sir Robert Moray was elected president he brought in a contribution on "A Relation concerning Barnicles," in which he relates of a visit to Scotland, where he found attached to a certain variety of trees innumerable little shells, each containing a little bird. He confesses that, while he found everything for "making up a perfect sea-fowle," he never saw any of the birds alive. "Here we have the absurd notion of the *Lepas anatifera* breeding geese, brought before the society by their president."

We find in the same minutes that "Dr. Clark was intreated to lay before the society Mr. Pellin's relation of the production of young vipers from the powder of the liver and lungs of vipers."

The Royal Society owes to the Hon. Robert Boyle more than to any other one person for its inception. A bachelor of independent fortune, he devoted his great resources, mental and material, to experimental researches, especially in relation to chemistry and of the atmosphere. An enthusiastic follower of Bacon, he believed and practiced the cherished doctrines of the great philosopher, that experiment and experiment is the only and sure method of founding a true science. A prodigy even in childhood, having entered Eton College when but eight years of age, he further enjoyed the advantages of European travels and education. He visited Florence in 1641, and spent the winter there studying the works of Galileo. He may have caught from the words of the then blind old astronomer, as he dictated to his disciples his last work on the "Impact of Bodies," that unwavering devotion to natural science which characterized both men. Returning to England, he gathered around him a circle of congenial friends, which formed the *Invisible College*, of which he in his works so frequently makes mention, and which subsequently became the Royal Society.

He was a prolific contributor to the "Transactions," all based upon his own investigations. His improved air-pump and his experiments with it contributed largely to the knowledge of the properties of air and the character of sound, and his work, "Experiments and Considerations upon Colours," prepared the way for Newton's more elaborate work upon the same subject. It is said that Boyle in the latter part of his life was accustomed, when engaged upon any of his important experiments, to write above his street-door, "Mr. Boyle can not be spoken with to-day."

The mere enumeration of the contributions of Boyle would fill a page, but he gleaned in too many fields to thoroughly exhaust any one. By his contemporaries Boyle was considered one of the greatest natural philosophers, and if the succeeding generations failed to retain the same high estimate of his position it is because he was succeeded by some of the greatest minds in English thought. It is sufficient for one man's fame that he originated the Royal Society.

November 12, 1662.—Robert Hooke, an assistant to Boyle, was elected a Fellow. He was but twenty-seven years old, yet as the result of his innumerable experiments "facts multiplied, leading phenomena became prominent, laws began to emerge, and generalizations to commence."

Hooke was possessed of a mind inventive and mechanical to a high degree, which led him to the threshold of some of the grandest discoveries of his time. His experiments, however, like Boyle's, were too diffuse, and he repeatedly was mortified by seeing his nearly completed discoveries anticipated. Hooke was a genius, but through lack of concentration cut a sorry figure, from always being a little too late. From the controversy with Huygens in relation to the invention of the balance-spring of watches, it was shown that he was entitled to the original conception, but that its practical application as a coil belongs to Huygens.

He had a faint conception of the undulatory theory of light; he discovered the mechanical laws which govern the motions of the heavenly bodies; and he so nearly discovered the law of gravitation that Newton was obliged to defend his claims before the Royal Society. Even in controversies such as that with Hevelius about an improvement of the telescope, where he had the best of the argument, his unmanly conduct and irascible temper destroyed all the honor he might otherwise have attained.

With a person misshapen and repulsive, with a temper as distorted as the body, miserly in his habits, and morbidly jealous of his co-laborers, Hooke's transcendent mind recalls the fable of the jewel in the frog's brain. Sir T. Molyneux, a contemporary, says, "Hooke is the most ill-natured, conceited man in the world, hated and despised by most of the Royal Society, pretending to have all other inventions, when once discovered by their authors to the world."

An ill-requited life Hooke's must have been to call forth upon his death the declaration that "society has gained more than science has lost."

August, 1663.—Charles II displays his continued interest in the society by presenting the president with the splendid mace, which has been borne, as the insignia of his office, before every president from that date to this. It is of silver, richly carved and gilded, and weighs one hundred and ninety ounces avoirdupois. With the mace is given the privilege of having two sergeants-at-mace, whose duty shall be to wait upon the president. It is borne before the president as he enters to his chair, and is placed before him upon a table during the proceedings of the meeting. When kings, princes of the blood, or distinguished ambassadors from foreign courts desire to visit the society, the president, attended by the mace and the sergeants-at-mace, meets them at the door and escorts them to a seat beside him on the dais. No meeting is legal unless held in the presence of this ensign of authority. The chief decoration of the enchased work of the mace is the thistle, the emblem of St. Andrew, who was the patron saint of the society. The anniversary meetings and election of officers were held upon St. Andrew's day, at which time the Fellows formerly wore a St. Andrew's cross in their hats. It is in the minutes of this year we find the resolution that "the president when in the chair is to be covered, notwithstanding the Fellows of the society be uncovered."

June 28, 1665.—The meetings were discontinued on account of the plague which was at that time devastating England, carrying off, from this date to the end of the year, seventy thousand persons in London alone.

On the 7th of June, 1665, Samuel Pepys for the first time saw two or three houses marked with the red cross and the words "Lord have mercy upon us!" on the doors. On the 4th of September he writes to Lady Carteret, "I have stayed in the city till above seventy-four hundred died in one week, and of them about six thousand of the plague, and little noise heard day or night but tolling of bells."

The meetings were renewed again March 14, 1666. As was to be expected, we find that the medical Fellows had some report to make of their studies of such a direful disease. In consideration of the present agitation of the germ theory of disease, it is interesting to find recorded that "Dr. Charlton advanced his notion concerning the vermigation of the air as the cause of the plague, first started in England by Sir George Ent, and Dr. Bacon in Rome. It had been observed that there was a kind of insect in the air, which, being put upon a man's hand, would lay eggs hardly discernible without a microscope, which eggs being for an experiment given to be snuffed up by a dog, the dog fell into a distemper, accompanied with all the symptoms of the plague."

September 5, 1666.—The journal has this passage: "The society could not meet by reason of the late dreadfull Fire in London."

The calamity of the many is often the opportunity for the few. The flames which brought such loss and suffering upon London, swept away all obstacles to the making of England's greatest architect. In the ashes of St. Paul's Wren found his opportunity and fame. Up to this time architecture had been but one of many of the studies of Sir Christopher. Even when a gentleman-commoner at Oxford he was noted for his attainments and inventions in mathematical and experimental philosophy. Mathematics, astronomy, chemistry, and anatomy shared with architecture in his attention, and such was his skill in them all that Evelyn styled him "that rare and early prodigy of universal science."

Wren was one of the founders of the Royal Society, and was at one time Professor of Astronomy at Gresham College, where the society first met. It has been justly observed that, "but for the fire, Wren might have trifled away his genius, patching the old cathedral, and perhaps adding a new wing to Whitehall." But fortunately the fire found him still young, being but thirty-three, and in the nearly threescore years still allotted him to labor, he industriously followed his chosen science. Besides fifty-odd churches, Wren designed and built the Royal Exchange, Custom-House, Royal Observatory, College of Physicians, Greenwich Hospital, Buckingham House, Marlborough House, the towers of the west front of Westminster Abbey, and many other noble structures. But the crowning work of his life was his remodeling and rebuilding St. Paul's, which is esteemed the finest specimen of its order in the world. Wren's salary as architect of this masterpiece was less than a thousand dollars per annum, for which he was not only architect but draughtsman, overseer, contractor, and auditor as well, besides, as the Duchess of Marlborough observed, "his being dragged up in a basket three or four times a week to the top of the building at great hazard."

Wren was a prominent Freemason, "was for eighteen years a member of the old Lodge of St. Paul's, then held at the Goose and Gridiron, near the cathedral, now the Lodge of Antiquity; and the records of that lodge show that the maul and trowel used at the laying of the stone of St. Paul's, together with a pair of carved mahogany candlesticks, were presented by Wren, and are now in possession of that lodge."

Wren was neglected by the court in his latter days, but amends were partially made at his death by a funeral of great distinction, and an interment in his own cathedral. Over his tomb in the crypt of St. Paul's were inscribed the words, worthy of the man and the place, "*Si monumentum requiris, circumspice!*"

November 23, 1667.—At the meeting of this date there was performed an experiment such as had never before been attempted in England. The year before Dr. Wallis had reported the success of some experiments made at Oxford by Dr. Lower, "of transfusing the blood of one animal into the body of another." But now the operation was to be tested upon a human being. A poor theological student, Arthur Coga or Coyn, offered himself as the subject. The operation was performed by Dr. Lower and Dr. King without any untoward symptoms arising. Some one asked the young man afterward why the blood of a sheep, rather than that of any other animal, was used in transfusion. He replied, "Sanguis ovis symbolicam quandam facultatem habet cum sanguine christi, quia Christus est Agnus Dei."

Harvey's discovery of the circulation of the blood, though for some time strenuously opposed, finally became accepted, and at once gave rise to the wildest speculations. In the blood were supposed to lie all the ills and diseases which tormented human life, and for their cure the bad blood had only to be drawn off, to be replaced by the pure blood of some young, healthy animal, when the sick would be restored, the maniac would recover his reason, old age return to youth again, and man become immortal.

Transfusion became the topic of the day. The courtier, the peasant, the man of science, followed every experiment with intense interest. It was a subject which appealed to the imagination and interest of every individual. If one may not secure immortality one way, may he not in another?

It is to the credit of the medical profession that as a body it deprecated the indiscriminate practice of such a hazardous experiment. There is no telling where the delirium may have carried the practice had not among the first cases occurred two deaths in

Paris, when it was prohibited in France except by the approbation of the Faculty of Paris, and later occurred two deaths in Rome, whereupon the Pope issued an edict forbidding transfusion within his domains.

December 21, 1671.—The minutes contain this sentence: "The Lord Bishop of Sarum (Dr. Seth Ward) proposed for candidate Mr. Isaac Newton, Professor of the Mathematicks at Cambridge." At this same meeting was shown a reflecting telescope made by Newton to overcome the objections hitherto pertaining to the refracting telescope. Upon receiving the society's hearty congratulations upon his invention, Newton promised to send the philosophical experiments which led to its construction. This promise he fulfilled, and the result was his famous work on "Optics." Newton now was fully launched upon that career as investigator and discoverer which has covered his name with immortal renown. He was yet scarcely thirty years of age. But even as a boy he had displayed an earnest of his future work by constructing windmills, water-clocks, and sun-dials; one of the latter is said to still mark the hours upon the walls of his old manor-house at Woolsthorpe, Lincolnshire; when only twenty-three he discovered his method of fluxions, by means of which the calculations of the movements of the planets were greatly facilitated, and he already was in possession of the principle of gravitation, which saw light sixteen years later, only because an erroneous estimate of the earth's diameter, which was a factor in his calculations, produced some inexplicable deviation from the result expected.

Newton, like Boyle, never married, but devoted his long life entirely to scientific and philosophical studies. Newton was elected President of the Royal Society in 1703, and successively re-elected until his death in 1727, thus making his presidency exceed that of any other, excepting Sir Joseph Banks, in the history of the society. This honor was not unfittingly bestowed, for there is no other name, in the long list of distinguished Fellows, whose life-work has reflected greater honor upon this already famous society.

In 1675 the Royal Society appealed to the king to establish an astronomical observatory for the study of astronomy and navigation. This the king consented to do, and commissioned Sir Christopher Wren to erect such a building at Greenwich. The Royal Society was given general supervision over its investigations, and evinced its solicitude by furnishing all the instruments used at the observatory during the first fifteen years.

Under Flamsteed as the first astronomical observator, or astronomer royal as the office was afterward called, and Halley as his successor, there began the long and unbroken series of important observations which have made the Observatory of Greenwich the most famous in the world. When, in 1698, Peter the Great visited England, he showed his great natural love for all that bore upon navigation by spending considerable time in the observatory and among the Fellows of the Royal Society. His quick mind evidently saw the advantages of such a society and observatory, for later in his life he established the Academy of Sciences and the National Observatory at St. Petersburg.

In 1695 Dr. Woodward, Fellow, brought forward his "Essay towards a Natural History of the Earth," which secured considerable notice from the great knowledge displayed upon geological subjects. He founded the professorship of Geology at Cambridge, and bequeathed his geological museum to the university at his death. In 1710 he managed to insult Sir Hans Sloane, then president of the society, for which the society demanded an apology. This he refused to give, and was expelled. He appealed to law for reinstatement, but failed. So ended the first quarrel in the history of the society. Woodward must have had a testy temper, for he had a quarrel with Dr. Mead over some medical topic about which they disagreed, and which resulted in a duel under the gate of Gresham College. During the duel Woodward's foot slipped and he fell. "Take your life!" exclaimed Dr. Mead. "Anything but your physic," replied Woodward.

1709 is the date of the death of Sir Godfrey Copley, Fellow, and the foundation by his will of the medal of that name, which has been so pertinently styled by Sir Humphry Davy "the ancient olive crown of the Royal Society." This medal is awarded yearly "to the living author (native or foreign) of such philosophical research, either published or communicated to the society, as may appear to the council to be deserving that honor," and many of the brightest men of science throughout the world have been recipients of this medal.

In 1752 England officially changed the calendar, the Royal Society, as would be supposed, being chiefly instrumental in the change. The bill was drawn up by president of the society Folkes, the secretary, Duval, and Astronomer Royal Bradley.

The Julian calendar, as instituted by Julius Cæsar, was so perfect that it was universally used until the sixteenth century. But as time ran on it was seen that the Julian year was eleven minutes longer than it should be, so that by 1582 there was a discrepancy of ten days. This resulted in great confusion in the Church, respecting the proper dating of Easter and all other movable feasts. Pope Gregory XIII set to work to correct this, and, by the recommendation of Lilius, a Neapolitan astronomer, proposed the *Gregorian Calendar* or *New Style*, in which he corrected the excessive ten days by declaring that the day following the 5th of

October, 1582, should be called the 15th, and, to correct the annual gain of eleven minutes, that every hundredth year should not be called a leap-year, excepting every four hundredth, beginning with the year 2000. All the Catholic powers immediately adopted the Pope's brief, but the Protestant countries, in their intense hatred of all that pertained to popery, refused to accept for a long time this evidently superior calendar. It was nearly two centuries before England accepted the New Style, and was the last of the European governments to surrender, except Russia, which clings to the Old Style to this day. Late as it was, the Royal Society, for recommending the change, shared in the opprobrium which fell upon the ministry who adopted it.

Whenever the prime minister appeared in public, mobs surrounded his carriage, demanding that he restore the days by which they supposed he had shortened their lives. When Astronomer Royal Bradley took sick and died amid the popular excitement, his death was believed to be a judgment of Heaven. This popular indignation extended even to the second generation; for when the son of Lord Macclesfield was standing for Parliament in the county of Oxford, the rabble greeted his appearance with the taunting words: "Give us back, you rascal, those eleven days which your father stole from us!"

In 1753 Franklin's electrical experiments won for him the Copley medal, a rare prize for one who was not a member of the Royal Society. In 1756 he enjoyed the further distinction of being elected Fellow, without having previously requested a member to propose his name, which had been the almost invariable custom and rule. Forasmuch as the society had elected Franklin without any advance on his part, it was considered but a graceful thing for it to release him from all annual dues, which was done. Franklin, on his part, fully repaid the society for its favors by frequently contributing to its "Transactions." When medals and honorary memberships in all the learned societies had been conferred upon him, when he had become the most talked-of and courted scientist in Europe, when his attentions conferred rather than received honors, even during the period of the Revolutionary War, Franklin kept up his friendly correspondence with members of the Royal Society, and the society rendered itself worthy of grateful remembrance by every American in its brave stand against lending itself to a narrow-minded sovereign to break down Franklin's scientific reputation.

Franklin's electrical experiments had led to his discovery of lightning-rods, of the power of rods and points to carry off safely the electrical shock. The accuracy of his experiments was generally conceded, but Abbé Nollet, in France, opposed the points and declared that the rods should be blunt. A Mr. Wilson raised the same objections in England. The question, which at other times would have been decided in scientific circles, became a political one. George III, in his eagerness to weaken Franklin's prestige, decided the scientific question like a king, adopted Wilson's views, and had blunt rods erected upon his palace. The Royal Society was appealed to. It emphatically declared for *pointed rods.* The president of the society, Sir John Pringle, was sent for, and royally commanded to support Wilson in the meetings. Sir John remonstrated: "Sire, I can not reverse the laws and operations of nature." George III modestly suggested, "Perhaps, Sir John. you had better resign."

Franklin's ready wit seized this incident to spit the king upon the point of this epigram:

"While you, great George, for knowledge hunt,
And sharp conductors change for blunt,
The nation's out of joint;
Franklin a wiser course pursues,
And all your thunder useless views,
By keeping to the *point.*"

When Halley predicted the transit of Venus in 1761, the Royal Society recommended the Government to send out capable men to India to make careful observations of this important astronomical event. For this purpose Mason and Dixon, two eminent astronomers and mathematicians, were dispatched, with all necessary apparatus, upon the Government vessel Sea-Horse, to Bencoolen.

An encounter with a French frigate drove the expedition into a friendly port. The astronomers proved poor soldiers, and they wrote home to have themselves released from the hazardous undertaking.

Their apparatus was better fitted for dealing with whirling bodies at a distance rather than at close range. However, the English Government commanded them to sail, which they with much trepidation proceeded to do, although the time wasted prevented them from reaching Bencoolen. They consequently landed at the Cape of Good Hope and made their observations there.

Mason and Dixon were later associated in an expedition which proved more successful. They landed in Philadelphia in 1763, and proceeded to survey, and settle for all time, the disputed boundary-line between the colonial patents of the Penns and Lord Baltimore. This line afterward became famous in American history from its division of the free and the slave States of the Union.

It is sad to relate that the society which could stand so bravely beside a non-resident member should so weakly yield to popular clamor as to break the last tie which held one of its most distinguished resident members to his country and home. It but illustrates the instability of human nature to find the Royal Society refuse to be used in the slightest manner to punish Franklin, who represented the bitterest hostility to George III and his ministry, and only a few years later demand the resignation of Dr. Joseph Priestley, who simply differed with the Established Church by demanding freedom of worship, and who differed with the Government by expressing sympathy for the American colonies and for the struggling French Republic. It counted little for Priestley that he had received the Copley medal for his electrical investigations and made it possible for chemistry to become a science by his discovery of oxygen. Priestley was a Non-conformist minister, and rendered himself intensely unpopular by continual debates with the Established clergy. His controversy with Dr. (afterward Bishop) Horsley was the most important theological controversy in the eighteenth century. In view of the invariable preferment given to Dr. Horsley and other opponents for their energy displayed in these contests, Priestley was led to make the stinging comment that he appointed the bishops of England. Hated and feared by the Established Church for his undoubted abilities and heresies, hated and feared by the Government for his dangerous political heresies, no protection was granted him when, upon the anniversary of the fall of the Bastile, a mob burned to the ground his house, with all his manuscripts and apparatus, and to escape personal violence the now old man fled for refuge to America, where he spent the remainder of his life.

In 1779 Count Rumford, adventurer, soldier, and scientist, was elected Fellow. Sir Benjamin Thompson's life reads like a romance. A poor New England lad, he at the outbreak of the Revolution sailed to England, where he spent the greater part of his life. He held many positions of honor and trust, both in England and Bavaria, and displayed marked ability as a statesman and as a general. But he is chiefly remembered for his scientific attainments. He founded the Rumford medal of the Royal Society, and enjoyed the unique distinction of being its first recipient. In 1802 the society decided that the medal be given "to Benjamin Count Rumford for his various discoveries on the subject of heat and light." Rumford founded the Royal Institute, at London, for the study of these subjects, and many of England's greatest chemists and physicists have lectured here under its auspices.

Various papers upon physical optics were read before the society by Dr. Thomas Young, during 1801–'3, containing his newly discovered law of interference of light, which led to the establishment of the undulatory theory of light. This discovery placed Young in the front rank of the natural philosophers of his day, but, as it often happens, his discovery was neglected in his own country until taken up and adopted abroad. Young was elected Fellow as soon as he reached his twenty-first year, which confirms to a certain extent the stories of his remarkable youthful attainments.

Besides being an eminent physician and writer on medical subjects, he delivered a course of philosophical lectures, served on the Board of Longitude, edited the "Nautical Almanac," and, most important of all, prosecuted his profound studies upon the Egyptian hieroglyphics, which led in 1818 to the successful interpretation of these hitherto sealed histories.

1806 is the date of the Bakerian lecture before the Royal Society, "On Some Chemical Agencies in Electricity," by Sir Humphry Davy, then but twenty-eight years old, but already the best-known chemist of his day. This brilliant memoir produced a profound sensation, and his lecture-room at the Royal Institute became a fashionable resort. Its scientific import was at once recognized over all Europe.

Although England and France were at war, the Institute of France awarded Davy the handsome prize of three thousand francs, offered by Bonaparte for the experiments best calculated to promote science; and when, a few years later, Napoleon allowed him to travel through France, the Institute elected him corresponding member of the first class. Upon his return to England, in 1815, Sir Humphry began his memorable investigation upon fire-damp, which had caused such havoc to life by explosions in the coal-mines.

As the outcome of his experiments was the invention of the safety-lamp known by his name, one of the many beneficent contributions which science is constantly conferring upon humanity. Davy deliberately refused to gain the fortune which its invention would surely have brought him, but the coal-miners showed their gratitude by presenting him with a handsome service of plate, and the Government conferred a baronetcy upon him. He received all the honors of the Royal Society, the Copley, the Royal and the Rumford medals, and was president of the society for a number of years. Sir Humphry was a highly imaginative, poetical writer, and a consummate scientific lecturer, but his presidency of the society was not among his most successful acts. After he had become famous, wealthy, and courted, he became arrogant and haughty, and, forgetful of his own lowly origin, talked much of aristocracy and high connections; so that, when he died, many recalled the epigram pronounced upon poor Hooke. Davy kept up the custom of his predecessor in office, Sir Joseph Banks, by appearing in a full court-dress when presiding over the transactions of the society. Withal, his presidency was a brilliant one, for among the contributing members during his term of office were Herschel, Buckland, Young, Dalton, Babbage, Brewster, and Faraday.

King George IV, in 1825, showed his interest in the Royal Society by proposing to award two gold medals, to be known as the Royal medals. The society accepted the proposal, and in the following year the first prize was bestowed upon John Dalton, of Manchester, "for the development of the chemical theory of definite proportions, usually called the atomic theory, and for his labors and discoveries in physical and chemical science."

The laws enunciated by Dalton upon the atomic theory are the greatest generalizations in chemistry, and at once placed it among the exact sciences. Dalton had an analytical, experimental turn of mind; patient, persevering, and painstaking, supreme in the laboratory, but almost destitute of social and literary instincts. When asked why he did not marry, he replied that he never had the time. One who had not time to seek a wife would not likely have the time nor the desire to seek general culture. So we are not surprised to hear him say that his entire library could be carried upon his back, and scarcely half of these had he read.

Dalton always wore the plain, colorless garb of the Friends, and only once appeared in public otherwise. When he was in London in 1834 his friends desired to present him to the king, but he refused to invest himself in the court-dress. He went arrayed in the scarlet doctor's robe, perfectly unconscious of the brilliancy of his attire; he was a victim of his friends' innocent conspiracy, for Dalton was color-blind.

In 1864 the Royal Society, through its president, Major-General Sabine, awarded the Copley medal to Charles Darwin, the author of the "Origin of Species." The president highly eulogized the merits of his works, "stamped throughout with the impress of the closest attention to minute details and accuracy of observation, combined with large powers of generalization." In 1839, upon his return from his voyage on the Beagle, the young naturalist, for his excellent papers on volcanic phenomena, was elected Fellow of the Royal Society, and at the anniversary meeting of the society in November, 1853, the Royal medal was presented him for his masterly treatise on "Coral Reefs." So, when the "Origin of Species" appeared, it was not from an unknown author, but one who had already attained a world-wide reputation. But no man's reputation, however great, could have saved so revolutionary a work as the "Origin" from the most violent opposition. It called forth grave reviews, satires, wit, even personal vituperation; but Darwin, in his rural home in Kent, received it all in a philosophic spirit, and abided his time. The "Origin of

Species" was the launching of the evolutionary movement, and, without discussing the validity of the doctrine, it is safe to say that it has given rise to the most forcible and puissant school of philosophy of the present day, and has affected science, in its myriad branches, more profoundly than any other scientific generalization since Newton's conception of the pervading force of gravitation.

During the early existence of the society the meetings were held in Gresham College, where many of its members were professors. In 1710 the society removed to Crane Court. In 1780 the president, Sir Joseph Banks, was instrumental in securing from the Government more comfortable accommodations in Somerset House. Their present location is at Burlington House, whither they moved in 1857. The meetings are held every Thursday at 4.30 P. M., from November to June; and of the communications read before the society, a "Committee of Papers" selects the most noteworthy for publication in the "Philosophical Transactions" or the "Proceedings of the Royal Society." Since the presidency of Sir Joseph Banks, membership in the society has been much more difficult to attain than formerly, from the great number of applicants for the limited vacancies to be filled each year. Each application for membership must be signed by six Fellows, three of whom must be personally acquainted with the applicant. From a list of such applicants, as it is often a long one, the Council of the society on the first Thursday of June each year selects fifteen by ballot, which selection is usually ratified by the society without change.

There is a corresponding class of foreign members, fifty in number, which includes the names of the foremost scientists throughout the world. No scientist is so eminent but feels honored by being elected Fellow of this ancient corporation, and to have one's labors crowned by one of its medals is a mark of the highest distinction.

THE luminous night-clouds which have been seen in Europe, at about the time of the summer solstice, since 1885, are mentioned by Herr Jesse as important subjects for accurate study. The author believes that they are interesting from an astronomical as well as meteorological point of view, because their periodic movement, taken in connection with their extraordinary height, suggests that they manifest the activity of cosmical forces. He holds, therefore, that they may throw some light upon the question whether cosmical space is filled with a resisting medium. Some other observers believe that the luminosity is a reflection from the very high solstitial sun. Herr Stubenrauch, meteorological observer at Punta Arenas, South America, informs Herr Jesse that he saw the phenomenon twice there in December, 1888—also near the summer solstice of his place of observation.

SPEECH AND SONG.

BY SIR MORELL MACKENZIE.

PART II.—SONG.

HAVING dealt in a previous article (see "Popular Science Monthly" for November, 1889) with the voice in its every-day garb of speech, it now remains for me to speak of it as it is when transfigured in song. The organ is the same in both cases, but in song it is used strictly as a musical instrument—one, too, of far more complex structure than any fashioned by the hand of man. The mechanism of voice has already been described, but, for the sake of clearness, it may be well to recall the three essential elements in its production: 1, the air-blast, or motive power; 2, the vibrating reed, or tone-producing apparatus; 3, the sounding-board, or re-enforcing cavities. These, to parody a well-worn physiological metaphor, are the three legs of the tripod of voice; defect in, or mismanagement of, any one of them is fatal to the musical efficiency of the vocal instrument. The air supplied by the lungs is molded into sound by the innumerable nimble little fingers of the muscles which move the vocal cords. These fingers (which prosaic anatomists call *fibers*), besides being almost countless in number, are arranged in so intricate a manner that every one who dissects them finds out something new, which, it is needless to say, is forthwith given to the world as an important discovery. It is probable that no amount of macerating or teasing out with pincers will ever bring us to "finality" in this matter; nor do I think it would profit us much as regards our knowledge of the physiology of the voice if the last tiny fibrilla of muscle were run to earth. The mind can form no clearer notions of the infinitely little than of the infinitely great, and the microscopic movements of these tiny strips of contractile tissue would be no more *real* to us than the figures which express the rapidity of light and the vast stretches of astronomical time and distance. Moreover, no two persons have their laryngeal muscles arranged in precisely the same manner, a circumstance which of itself goes a considerable way toward explaining the almost infinite variety of human voices. The wonderful diversity of expression in faces which structurally, as we may say, are almost identical, is due to minute differences in the arrangement of the little muscles which move the skin. The same thing holds good of the larynx. In addition to this there are more appreciable differences, such as we see in the other parts of the body. The larynx itself is as various in size and shape as the nose; and this is still more the case with the other parts concerned in the production of the voice. The most laborious anatomical Gradgrind would shrink appalled from the attempt to measure the capacity and trace the shape of the various resonance chambers—chest, throat, mouth, and nose, with the many intricate little passages and cave-like spaces communicating with the latter—yet the slightest difference in the form, size, or material structure of any of these parts must have its effect in modifying the voice to some extent.

It is a curious fact that singers, who are often rather unwilling to believe that the voice is formed solely in the larynx, are yet generally surprised to be told that the true nature of the voice can not be certainly determined by examination of that organ. From what has been said as to the extraordinary number of the component parts of the vocal machine, it will be evident that it would be almost as rash to pronounce on the nature of the voice from the appearance of the larynx as it would be to take the shape of the nose as an index of moral character. It can only be said in a general way that, other things (notably, the resonance chambers) being equal, one expects a large, roomy larynx, with thick, powerful cords, to yield a deep, massive voice, and a small organ, with slender cords, to send forth a shrill, high-pitched voice. These two types represent the male and female voice respectively; that of the child belongs to the latter category. It must be understood that the difference in size between the largest larynx and the smallest is, after all, very trifling in itself. For instance, the vocal cords in women are but a fraction of an inch shorter than in men, and the other dimensions vary in much the same proportion. A like difference prevails throughout the resonant apparatus, the re-enforcing chambers being larger in men, and their walls (which are built up of bone, gristle, and muscle) denser and more solid.

The voice varies in compass no less than in quality. *A priori* long vocal cords should indicate great range of tone, but so much depends on the management of these vibrating reeds that comparatively little significance can be attached to mere length. The average compass of the singing voice is from two to three octaves, the latter limit being seldom exceeded. The artistic effect produced with this small stock of available notes is as wonderful in its way as the marvelous results that can be got out of the twenty-six letters of the alphabet. In singing up the scale, the vocalist feels that at a certain point he has to alter his method of production in order to reach the higher notes. This point marks the breaks between the so-called "chest" and "head" registers, or what I may call the lower and upper stories of the voice.

The subject of the registers has been much debated by the learned, and still more perhaps by the unlearned; it is the "Eastern question" of vocal physiology. Quite a considerable literature has gathered round it; philosophers have lost their tempers and musicians have shown a plentiful lack of harmony in discussing it. The inherent difficulties of the subject have been increased by the fantastic terminology which has come down to us from a pre-scientific age, and by the erroneous observations of incompetent persons. I can touch only very lightly on the subject here, but those who wish for a full exposition of my views on the matter may be referred to a little work which I published some years ago, and which has been translated into eight languages.* It may be asked, What is a register? The best definition I can offer is that it is a series of tones of like quality produced by a particular adjustment of the vocal cords to receive the air-blast from the lungs. The question is what the "particular adjustment" is in each case. The first step toward clearing up the subject is to discard the terms "chest" and "head" voice, which are meaningless and often misleading. Whatever number of registers there may be, and however they may be produced, it is certain that the change of mechanism takes place only in the larynx. I have suggested that the terms "long reed" and "short reed" register should be used to designate the two fundamental divisions of the human voice. In the former, usually called "chest voice," the vocal cords vibrate in their whole length, and the sounds are re-enforced largely by the cavity of the chest, the walls of which can be felt to vibrate strongly when this register is used. In the latter, "head voice," or falsetto, only a part of the cord vibrates, and the sound is re-enforced by the upper resonators, mouth, bony cavities of the skull, etc. It is this which has given rise to the absurd statements of singers that they could *feel* their head notes coming from the back of the nose, the forehead, etc. In the "long reed" register the pitch is raised by increasing tension of the vibrating element; in the "short reed" register by gradual shortening of it. This is effected by a curious process, which can be distinctly seen in the living throat with the laryngoscope. The two cords are forced against each other at their hinder part with such force as to stop each other's movement. While the notes of the chest register issue from the natural aperture of the larynx, the head notes come through an artificially diminished orifice, the chink becoming gradually smaller till there is nothing left to vibrate, when the limit of the voice is reached. The two registers generally overlap for a greater or less extent, a few notes about the middle of the voice being capable of being sung in either. Some voices have no break in their entire compass, the same mechanism being used throughout, but this is very rare. It was the constant aim of the famous old Italian singing-masters to *unite* the two natural registers so perfectly that no break should be perceptible.

Till a comparatively recent date the generally received explanation of the registers was that, while in the delivery of chest notes the whole substance of the vocal cord vibrated, in the "head" voice only its thin inner margin did so; in both cases the entire *length* of the cord was supposed to vibrate. The shortening of the vibrating reed, however, by the mutual "stopping" process mentioned above, is not a theory, but a *fact* which can be seen. I am inclined to believe, however, that under certain circumstances the two processes of shortening and marginal vibration may be combined. This may possibly be the true mechanism of the falsetto voice, as to which there has been so much dispute. It is clear that the term has been used by different persons in different senses, and much of the confusion which exists on the subject is, in my opinion, due to this cause. By most of the old Italian writers, the term falsetto is used as synonymous with head voice; by others it is employed to denote that kind of voice "whereby a man going beyond the upper limit of his natural voice counterfeits that of a woman" (Rousseau, "Dictionnaire de Musique"). A similar difference of opinion exists as to the beauty of falsetto, some speaking rapturously of its flute-like softness, others reviling it as "the most disagreeable of all *timbres* of the human voice" (Rousseau, ibid.). I venture with all humility to submit that "falsetto" and "head voice" should not be used interchangeably. The "long reed" and "short reed" registers are used alike by the two sexes, the greater part of the male voice, however, belonging to the former, and the greater part of the female to the latter. The term "falsetto" should be reserved for the artificial method of delivery, by which the limited "short reed" register in men is forced upward beyond its natural compass. In this mode of production the air is blown up from the lungs so gently that it has not sufficient power to throw the whole thickness of the vocal cord into vibration. This accounts for the soft, "flute-like" tones which are characteristic of the falsetto voice.

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* "Hygiene of the Vocal Organs," Macmillan & Co., sixth edition, 1888.

To sum up the mechanism of the registers, there is first the "long reed" or "chest" register, in which the cords vibrate in their whole length and thickness; then the "short reed" or "head" register, in which the vibrating reed is gradually shortened; lastly, the falsetto, which belongs to men alone, and is formed by the vibration of the margins only of the shortened reeds. Pitch rises in the long reed register owing to increasing tension of the cords, accompanied by increasing rapidity of vibration; when the cord can not be made more tense, the device of shortening the reed is brought into play. In the upper register not only is the aperture between the cords ("glottis") diminished to the smallest possible size, but the whole upper orifice of the larynx is compressed from side to side, so as to leave only a very narrow chink for the voice to pass through. In the lower register, on the other hand, the larynx is wide open, and the vibrating air rushes forth in a full, broad stream of sound.

Many singing-masters, not content with the great natural divisions of the voice which have just been indicated, insist that there are five different registers, each with a distinct mechanism of its own. I am not a *maestro*, and therefore I am willing to admit that, artistically speaking, there *ought* to be five registers, or, in fact, any number of them that may be thought desirable. But if that is a necessity of art, it is not a necessity of Nature, which does all that is required by the simple process which has been described. The differences of mechanism on which the singing-masters profess to base their division are mostly of so subtle a nature as to be almost invisible to the eye, and sometimes even hardly appreciable by the ordinary intellect. I think, however, there is a way of reconciling their views with mine, diametrically opposed as they at first sight seem to be. As a physiologist, I speak solely of the tone of a note, that is to say, of its place in the musical scale, and I say, That note is delivered by the long reed or short reed adjustment, as the case may be; as musicians, on the other hand, the *maestri*, speaking of the quality as well as the tone, say, That note ought to be delivered in such and such a way to make it artistically beautiful. In the one case, in short, the voice is considered purely as it is produced in the larynx; in the other, as it is delivered by a well-trained singer managing his resonance apparatus to the best advantage. Now, for this result many things are needed besides the correct adjustment of the vocal cords. The supply of breath must be regulated to a nicety, and the position of the tongue, soft palate, cheeks, and lips must be precisely that which is best for the utterance of each particular note. There are rules founded on experience which govern all these things; these rules are expressed in terms of subjective sensations, which are scientifically absurd, but, at the same time, may be practically useful, as indicating the feelings that should accompany the right performance of the manœuvre required. It is on all this complicated mechanism that the five registers of the singing-masters are based; the more or less fanciful changes in the larynx, to which they attribute the slight, but artistically vital, differences in production which their trained ear enables them to appreciate, have in reality but little share in the result. The difference between artistic and inartistic production of the voice depends far more on the management of the resonators than on the adjustment of the vocal cords.

This point will be better understood if it is borne in mind that, as Helmholtz has shown, every musical sound is "compounded of many simples"; that is to say, the fundamental tone is re-enforced by a number of secondary sounds or "harmonics" which accompany, and as it were echo, it in a higher key, the whole being blended into one sensation to the ear. Then, again, it is well known that every resonance cavity has what may be called an "elective affinity" for one particular note, to the vibrations of which it responds sympathetically, like a lover's heart answering that of his beloved. As the crude note issues from the larynx, the mouth, tongue, and soft palate mold themselves by the most delicately adapted movements into every conceivable variety of shape, clothing the raw bones of sound with body and living richness of tone. Each of the various resonance chambers re-echoes its corresponding tone, so that a single well-delivered note is in reality a full choir of harmonious sounds.

It has further been proved that each vowel has its own special pitch, and hence it can not be sounded in perfection on any other. The different vowels, in fact, are produced by modifications in the length and shape of the cavity of the mouth, and the note of each one of them is that to which such a resonance chamber naturally responds. It follows from this that, in order to get the best effect from the vocal instrument, there should be the most perfect possible adaptation of the various vowels to the notes on which they are to be sung. Sounds like *o* and *ou* (*oo*) are best rendered in the lower notes of the voice; *a* and *i* (*ee*) in the upper. It is difficult, indeed almost impossible, to sing the latter vowels on deep notes. The marriage of music to immortal verse can not be perfect unless the various affinities of the vowel sounds are carefully respected by the composer.

From what has been said it will, I think, be evident that no one, however happily gifted in point of voice, can use his endowment to the best advantage without careful training. Every note requires for its artistic production, not only a particular adjustment of the larynx, but a special arrangement of the resonators and suitable management of the breath, all the complicated movements involved in these various proceedings having to be performed automatically and with the most exact precision, and the whole being combined into one instantaneous act. M. Jourdain's master was not such a fool as he is made to appear, when he insisted on the mechanism of utterance being clearly understood. When this has been acquired, the singer is still only like a child that has learned to stand; walking, running, and dancing, in other words the junction of the separate notes into the "linked sweetness" of an air, the graces and ornaments of vocalization, and the secret of sympathetic expression have yet to be acquired. There is an unfortunate tendency at the present day to be satisfied with a very inadequate amount of training, and I can not help thinking that this is partly due to an imperfect appreciation of its necessity. Years are ungrudgingly given to acquiring a mastery of the piano or violin, and it is recognized that to excel with either of these instruments seven or eight hours of laborious practice every day are necessary. Yet many seem to fancy that the voice can be trained in a few months. How preposterous such a notion is must be evident to any one who takes the trouble to think about the matter. In the case of the violin or piano the instrument is perfect from the outset, and the student has only to learn to play it; the singer, on the other hand, has to develop—in some cases almost to create—his instrument, and then to master the *technique* of it. The human larynx is, as already said, a musical instrument of the most complicated kind, for its two reeds are susceptible of almost infinite modification in size, shape, manner of vibration, etc. A distinguished surgeon not long ago edified the public by a calculation of the number of muscular movements executed by a young lady while performing a simple piece on the piano; it would be hopelessly impossible to count the movements of the muscles which work the vocal cords.

The details of vocal training I must leave to the singing-masters; I can only touch on one or two points which lie more or less within my own province. In the first place, the vocal organs must be strengthened and developed by exercise. The excellent maxim, *Memoria excolendo augetur,* which we learned from the Latin grammar, is equally true of muscle, and a singer's thyro-arytænoidei should be in as good condition as a pugilist's biceps. Such modes of life as are good for the general health will also help to improve the voice by expanding the chest and keeping all the organs at their maximum of efficiency. In order to "know the stops" of the vocal instrument, so as to be able to "command it to any utterance of harmony," training must be directed to each of the three factors of voice. The art of so governing the breath that not a particle of it shall escape without giving up its mechanical equivalent of sound must first of all be acquired. The vocal cords must use the breath as Jacob did the angel with whom he wrestled; they must not suffer it to depart till it has blessed them. The first thing the singer has to do is to learn to breathe; he must fill his lungs without gasping, and empty them quickly or slowly, gently or with violence, according to his needs. Much has been written on this matter with which I need not perplex the reader. The problem is how the lungs can be replenished most advantageously for the purposes of the singer. The chest is expanded by pulling up the ribs, and by pushing down the diaphragm, or muscular partition which separates the chest from the abdomen. In violent inspiratory effort the collar-bone may be forcibly drawn up by the muscles attached to it, but this mechanism is seldom brought into play except in the dire struggle for breath when suffocation is impending. It is a curious fact that men breathe differently from women, the former using the abdominal method—that is, pushing down the diaphragm—and the latter doing most of the work with their upper ribs. One reason of this difference is that the fair sex insist on fixing their lower ribs, to which the diaphragm is attached, with stays, which make free movement of that muscle impossible. Doctors have fulminated against tight-lacing for the last three centuries,* but to as little purpose as the Archbishop of Rheims thundered against the jackdaw. Fashion must be obeyed, whatever its victims may have to suffer. It is right to state, however, that stays not long ago found a champion in no less a person than the Professor of Pathology in the University of Cambridge. Professor Roy caused a little mild scandal at the last meeting of the British Association by urging that the use of stays might have certain advantages. If the Archbishop of Canterbury had stood up in Convocation and denied the efficacy of baptism, he could not have shocked his hearers more than Dr. Roy did by such a profession of heresy. The scientific ladies, who resemble the Greek statues in the looseness of their waists if in nothing else, groaned over this backsliding in high places, and their more frivolous sisters rejoiced. A Defender of the Faith, however, opportunely appeared in the person of Dr. Garson, who at once put the question to the touch by measurements made on a number of ladies and gentlemen then present. These showed that the vital capacity (which is measured by the quantity of air that can be expelled from the lungs after the deepest possible inspiration) was considerably greater in the men than in the women, and that while in the former there was a constant diminution in the vital capacity in every period of ten years after the age of thirty, in the latter it actually increased after fifty, a time of life at which the majority of ladies begin to think more of comfort than of restraining the exuberance of their "figure." The truth appears to be, however, that the slight pressure exercised by stays does not matter in the case of ladies who are not called upon to use their voices professionally, and who do not care to excel as amateurs. In the ordinary work of life stays do not cause any inconvenience, and it is only when they are absurdly tight that they do serious harm to the internal organs. In the case of the *artiste* it is quite otherwise; here anything which in the smallest degree diminishes the vital capacity seriously handicaps the singer.

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* Stays are generally said to have been introduced by Catherine de Medicis, who may be supposed to have had a natural genius for the invention of instruments of torture. They were, however, in use long before her time. I have in my possession a drawing made for me in 1884 by Mr. Lewis Wingfield from a MS. in the British Museum of the date 1043. It is figured by Strutt, who calls it "A Droll Devil." Mr. Wingfield more aptly terms it the "Fiend of Fashion." It represents a figure fantastically dressed in what, I suppose, was the height of fashion of the day. Its special interest in connection with the present subject is that it wears a pair of stays, laced up in front, and of sufficient constrictive power to please a modern *mondaine*.

Although the abdominal mode of breathing may be the *natural* method of inspiration, there can, I think, be no doubt that in singing it is not the most effective. On this point the empirical traditions of singing-masters were abandoned some years ago in favor of what was supposed to be the teaching of science, and now singers are often taught to breathe by pushing down the diaphragm and protruding the stomach. Anatomists are, however, beginning to see that the Italian masters were right in insisting that the diaphragm should be fixed, and the abdomen flat in inspiration; in this method there is great expansion of the lower ribs, and the increase in the capacity of the chest takes place chiefly in this direction. In this form of breathing there is far more control over expiration than when the diaphragm is displaced; the act can be regulated absolutely by the will to suit the requirements of the vocalist. Abdominal inspiration is apt, on the other hand, to be followed by jerky expiration, a defect which is fatal to artistic delivery and most fatiguing to the singer.

The training of the other parts of the vocal machinery, the vibrating element and the resonant apparatus, lies altogether outside my province. What I may call the "fingering" of the vocal cords and the "tuning" of the resonators can be acquired only by constant practice under a good teacher. There is no such thing as a self-taught singer. Constant imitation of the best models and the watchful discipline of an experienced instructor constitute the real secret of the old Italian schools of singing, which gave such splendid results. Tosi insisted that the pupil should never sing at all except in the presence of a master. It is important that the very best teacher that can be found should be chosen; it is a false economy to trust a young voice to an inferior man on the ground of cheapness. To masters I venture to hint that they should strive to train their pupils according to the traditions of the golden age of song before the laryngoscope was invented.

I have only to add that the ear should be not less carefully trained than the vocal organs. An old Scotch minister used to tell his flock that the conscience should be kept "as white as the breest o' a clean sark." The ear is the conscience of the voice, and its purity should be not less jealously guarded. Many singers of the finest vocal endowment fail from a defect of ear; their condition is like that of a color-blind painter. Passing indisposition may sometimes vitiate the ear as well as the temper; the artist should on no account attempt to sing under such circumstances.

Two questions in connection with the training of the voice still remain to be discussed—viz., when it should be commenced, and whether it should be interrupted during the so-called "cracking" period. With regard to the first of these questions I am strongly of opinion that training can hardly be begun too early. Of course, the kind and amount of practice that are necessary in the adult would be monstrous in a young child, but there is no reason why, even at the age of six or seven, the right method of voice-production should not be taught. Singing, like every other art, is chiefly learned by *imitation*, and it seems a pity to lose the advantage of those precious early years when that faculty is most highly developed. There is no fear of injuring the larynx or straining the voice by elementary instruction of this kind; on the contrary, it is habitual faulty vocalization which is pernicious. The sooner the right way of using the voice is taught the more easy will it be to guard against the contraction of bad habits, which can only be corrected at a later period with infinite trouble. Many of the finest voices have been trained almost from the cradle, so to speak. I need only mention Adelina Patti, Christine Nilsson, Jenny Lind, and Madame Albani; but there are numbers of other queens of song who owe great part of their success to the same cause.

As for the other point, I am still an obstinate dissenter from the "orthodox" teaching of singing-masters on the subject. I have already more than once expressed my belief that there is no reason why training, *within certain limits and under strict supervision by a competent person*, should not be carried on when the voice is in the transition stage of its development from childhood to adolescence. The stock argument, invariably advanced to prove the necessity of suspending the education of the voice till it has passed through the "breaking" period, is that, as the parts are undergoing active changes, they therefore require complete rest. This would equally apply to the limbs, and, in some degree, also to the brain. Yet I am not aware that it has ever been proposed to forbid growing lads from exercising their bodies, even in games involving considerable muscular violence, or to interrupt the education of the mental powers till the brain has become fully formed. Overpressure there may be, no doubt, in voice-training as in other kinds of instruction. All voices are not capable of bearing the same amount of training. Each case must be dealt with according to what doctors call the particular "indications" that may arise. My thesis holds good only as a general rule, to which there may be many individual exceptions. A judicious teacher will, however, have no difficulty in deciding as to the best course to adopt in any given instance.

After the voice has been developed to its utmost capacity, the next thing is to keep it in perfect condition. How is this to be done? As Danton said that the three things needed to insure success were *De l'audace, de l'audace, et encore de l'audace*, I say the three things necessary to keep the voice in good order are practice, practice, and again practice. A singer who lets his voice lie idle is pretty sure to lose some of his upper notes, his breathing-power falls below its highest standard, and the larynx becomes less supple and less obedient to his will. Another vital point is never, if possible, to use the voice when it is not at its best. The slightest cold deadens to some extent the vibrations of the cords, and the resonators are also thrown out of tune by dryness or excessive moisture of their lining membranes. Bodily weakness or indisposition is reflected in the voice; the cords do not come firmly together, and their tension is insufficient for perfect purity, much less richness, of tone. A most essential element in the care of the voice is attention to the general health. This is very apt to be neglected by singers, who have rather a tendency, as a class, to lead the life of hot-house plants, living in rooms from which fresh air is shut out almost as if it were a pestilence, and taking little or no physical exercise. It is right, no doubt, that a singer should shield his precious instrument from harm as carefully as a violinist protects his Straduarius or Amati, but exaggerated precaution may defeat its object. Even the most dainty of light tenors can not live wrapped up in cotton-wool, and the delicacy engendered by the unhealthy conditions of life which have been referred to makes the slightest exposure to cold or fog almost deadly to his artificially enervated throat. A singer who wishes to keep himself in good voice should rise, if not exactly with his brother minstrel, the lark, at least pretty early, say, before eight in the morning. Tosi says that the best hour for practice is the first of the sun, but this, I fear, is a "counsel of perfection" beyond the virtue of this unheroic age. The singer should take plenty of exercise in the open air, and should harden his constitution by leading, as far as possible, a healthy outdoor life. Nothing gives richness and volume to the voice like vigorous health; an experienced ear can often tell a man's physical condition by the full, generous "ring" of his tones, both in singing and speaking.

There is even more superstition among singers than among speakers, as to what is "good for the voice." A formidable list of things which were supposed by the ancients to be injurious is given by Pliny; it includes such a variety of animal and vegetable substances that one wonders how unfortunate vocalists could have found life worth living under such ultra-Spartan conditions. Our modern *artistes* tend to err rather in the opposite direction, to judge from their extraordinarily comprehensive views as to what is "good" for the voice. Every species of drink, from champagne to hot water, and almost every recognized article of food, including that particularly British institution, cold roast beef, has its devotees. I have no manner of doubt that every one of these things is really beneficial, not from any occult virtue that there is in them, but because the solids give strength, while the liquids moisten and lubricate the throat. That is the whole secret of the cordials and elixirs in which many vocalists place their trust.

A useful example of the proper care of the voice is to be found in a very unexpected quarter. The Emperor Nero, as is well known, believed himself to be a great artist, a notion of which those about were not likely to disabuse him. His dying words, "*Qualis artifex pereo!*" show that he had at least one feature of the artistic temperament. He sought fame by many paths—in poetry, fiddling, driving, and other branches of the fine arts—to say nothing of his scientific experiments on the bodies of his nearest relations. The imperial *virtuoso* was particularly vain of his voice, which I can well imagine to have been soft and sweet, qualities which often enough accompany a cruel nature. He was proportionately careful of so precious a possession. His system is worth quoting. In addition to such general measures as attending to his liver, and abstaining from such fruits and other food as he fancied to be injurious to his voice, we are told that at night he used to lie on his back with a small plate of lead on his stomach. This was probably for the purpose of checking the tendency to abdominal breathing, which has already been referred to as the less perfect way in respiration for singers. In order to spare his voice all unnecessary fatigue, he gave up haranguing his troops and ceased even to address the Senate. As in later times there were keepers of the king's conscience, Nero gave his voice into the keeping of a *phonascus*. He spoke only in the presence of this vocal director, whose duty it was to warn him when his tones became too loud, or when he seemed to be in danger of straining his voice. To the same functionary was intrusted the formidable duty of checking the emperor's eloquence when it became too impetuous; this he did by covering the imperial orator's mouth with a napkin. It must have needed no small measure of courage to apply this effectual method of "closure" to the arch-tyrant of history when intoxicated with the exuberance of his own vocalization.

While laying stress on the necessity of proper cultivation in order to make the singer capable of giving the greatest pleasure to his hearers with the least amount of fatigue to himself, I venture to add that many singers who are admirably trained have rather a tendency to "o'erstep the modesty of nature" in their delivery. It was said of Flaubert's Salammbô, that it might be Carthaginian, but it was not human; in the same way I am disposed to say of certain highly "artistic" vocal displays which one is sometimes condemned to hear, that it may be song but it assuredly is not music. When listening to such tremendous performances, I often find myself echoing the words of poor Christopher Sly: "'Tis a very excellent piece of work, madam lady; would 'twere done!" An old Italian writer, himself both a singer and a teacher, most truly says: "*E vaglia 'l vero, dove parla la passione i trilli e i passaggi devon tacere*"—leaving the soul to be moved solely by the beauty of expression. It was this quality of sympathetic expression that made the singing of Tom Moore, who had no "voice" in the technical sense, more moving than that of renowned artists. In an altogether different line, Mr. George Grossmith contrives by the exquisite clearness of his modulation to add considerably to the gayety of nations with a very limited stock of notes.

One of the most remarkable things relating to song at the present day is the scarcity of really fine voices. It will not, I suppose, be seriously argued that the human voice is degenerating, and never were the inducements to cultivate it more abundant or more powerful. Yet, if we are to believe many competent authorities, never were first-rate voices so rare as at the present time. The complaint is not altogether new, and is, in part at least, nothing more than the inevitable moan of the *laudator temporis acti* over the decadence of things in general. Rossini at the zenith of his fame complained that there were so few good voices, and quite at the beginning of the last century we find Tosi speaking of his own period as one of decay. Mancini also (1774) says that vocal art had then fallen very low, a circumstance which he attributes to singers "having forgotten the old systems and the sound practice of the ancient schools." Still, modern writers on singing are agreed that there is a dearth of really beautiful voices at the present time, and, as this is one of the very few points on which these contentious persons are agreed, there can be little doubt of the truth of the fact to which they bear witness. Good tenors are especially rare, even among Italians, the chosen people of song. There are no tenors now who can be compared with Mario or Rubini; indeed, one gathers from Mr. Sims Reeves's reminiscences, published not long ago, that the world is at present blest with only one really first-rate tenor. Mr. Reeves leaves his readers in no doubt as to the identity of this Triton among contemporaneous minnows of song. We have no basso that can stand beside Lablache. Except Madame Patti, whose glorious voice is now too seldom heard, and Madame Christine Nilsson, who, to the regret of all lovers of song, has quitted the lyric stage, Madame Albani and Madame Sembrich are almost the sole inheritors of the renown of the great *prime donne* of old. It is not only in compass and quality that our latter-day voices are inferior to those of preceding generations, but in endurance. Catalani's magnificent voice remained unimpaired up to extreme old age, and Farinelli's only died with him. Matteucci, when past his eightieth year, used to sing in church every Sunday *per mera devozione*, and such was the freshness and flexibility of his voice that those who could not see him took it to be that of a young man in the flower of his age. Indeed, this was not very uncommon in singers trained according to the best traditions of the old Italian school, which seems to have possessed the secret of perpetual youth as far as the voice was concerned.

Now, to what can our poverty in voices of the highest class be due? I believe to a combination of three different causes: First, inadequacy of training; secondly, the want of good teachers; and, thirdly, the gradual rise of the concert pitch which has taken place in recent years. Insufficient training arises from the breathless haste to "succeed" which is a characteristic of this feverish age. Voices are quickly run up by contract, and as swiftly fall into decay. The preference for supposed "royal roads" over the hard-beaten path that has led former singers to fame is another error which has worked almost as much mischief in song as it has in scholarship. A vocalist nowadays thinks that a year in England and a second year in Italy is all that is needed to equip him for a brilliant artistic career. In "the brave days of old" singers never deemed their vocal education complete until they had given six or seven years to the ceaseless study of their art.

The want of good teachers is closely connected with the inadequacy of modern training, for it is evident that a man who has not himself had the patience or the industry to master his art can not be a satisfactory guide to others. Show and superficial brilliancy of execution are aimed at rather than solidity and thoroughness; more attention is paid to vocal *tours de force* than to artistic ornament. The firm basis of experience has been abandoned for fantastic methods of teaching which are useless when they are not positively harmful. I would earnestly advise all those who profess to impart the divine art of song, like Prospero, to "drown their books," and study the production of the voice as an art, and not as a branch of Chinese metaphysics.

That the high concert pitch now generally used, especially in this country, throws an unnatural strain on even the finest voices, is a fact as to which most authorities are agreed. In the classical period of music, A (second space, treble clef) represented from four hundred and fifteen to four hundred and twenty-nine vibrations; this pitch suited the human voice admirably. The desire to get increasingly brilliant effects from the orchestra forced the pitch higher and higher, till so much confusion prevailed that, in 1859, a French commission fixed the standard pitch at four hundred and thirty-five vibrations. This is called the normal diapason, and is now generally used on the Continent; but England, with her customary insular independence, has not conformed to the general rule in the matter, and the pitch has in this country actually risen to four hundred and fifty-eight vibrations. This result is largely due to the extraordinary impulse given to orchestral music by the genius of Costa, who, so long as he could get brilliant effects from his instruments, cared little for the consequences which the rise of pitch entailed on the voice. But it will be said, since it is all a matter of convention, why can not the pitch be lowered? I believe the chief obstacle is the expense which this would involve through the necessity of altering instruments. It has been estimated that it would cost eighty thousand pounds to alter those of the military bands alone, and politicians probably think that these are hardly the times to ask for money for such an object.

But worse even than the undue height of the pitch is the difference between this country and the rest of the civilized world which has just been referred to. Herr Joachim complains that he is obliged to begin screwing up his violin eight weeks before he comes to England, in order that the instrument may not be injured by a sudden change. It is not so easy, however, for the singer to prepare *his* delicately strung instrument in the same way, and the result is necessarily great strain to the vocal cords and throat generally. The high pitch used in England leads to the production of very disagreeable shrieking; notes are delivered which are in no sense artistically beautiful, and which only "split the ears of the groundlings." Nearly all singers are in favor of lowering the pitch. The sole exceptions are, I believe, the contraltos, whom a high pitch does not affect so much as it does others. I know of one justly celebrated contralto who produces an extraordinary effect by her low E. If the pitch were altered this vocal feat would no longer be so wonderful, and it is natural, therefore, that this lady should wish the present state of things to continue.

Perhaps, after all, the supposed scarcity of good voices may be more apparent than real. It is possible that it is not only the pitch but the standard of vocal excellence that has risen. We know how the general level of literary style has risen, and, in particular, how the art of melodious versification has been popularized, if I may use the expression, so that every cheap magazine, and even the poets' corner of provincial newspapers, contains copies of verses which would have earned considerable reputation for the authors a hundred and fifty years ago. It is immensely more difficult now to make a name by writing. May not something of the same kind be the case as regards singing? I fear we must not lay that flattering unction to our souls. Great singers are rarer nowadays than in former times, because voice-training is almost a lost art. The remedy lies, as has been said, in a return to methods consecrated by glorious tradition, and fruitful of results which, as experience has abundantly proved, can not be attained by shorter or easier ways.—*Contemporary Review.*

[*Concluded.*]

SUSPENSION OF VITALITY IN ANIMALS.

BY M. VICTOR LAPORTE.

FAMILIAR instances of suspended vitality, or rather latent vitality, are afforded by seeds, which may be kept for years without showing action, but are yet capable of being recalled to the exercise of the functions of life. Other instances are afforded by the lower organisms, which will remain dry and sterile for indefinite periods, to be brought into full activity at any time by supplying the due degree of moisture and warmth. Coming up to higher forms of life, the same phenomena are usually manifested in insects, one of the normal conditions of whose life—the *nympha* or *chrysalis* state—is characterized by the exhibition of the external appearance of death. During this stage the vital processes are tempered down till only enough are in effect to maintain a merely vegetative existence; yet the insect is capable of slight motions when subjected to a shock or pressure. The duration of this apparent death varies according to the species and to external conditions. There are species that require two years of incubation before going through their metamorphosis. Others pass to the perfect state in a few days. Butterflies demand a certain degree of heat, below which they will not issue. The opening of the chrysalis takes place naturally when these atmospheric conditions are realized. If the season is late, the hatching is also late. Hence we can prolong the duration of the chrysalis state indefinitely by properly adjusting the temperature, delaying to that extent the metamorphosis of the imprisoned mummy into the free and winged insect. Réaumur, by putting chrysalides in an ice-box, was able to keep them alive and retard their development several years.

"Perfect" insects are also capable of passing some time in a more or less definite condition of apparent death without losing the capacity to revive. I do not mean those simulations of death which some species put on in order to escape their enemies, and under which their condition may be mistaken by the most careful and patient observer, but cases in which they revive under really extraordinary conditions. Of such cases are instances of flies, which, having been accidentally inclosed in casks of Madeira wine shipped to Europe, became lively as soon as they were exposed to the air. Frozen caterpillars are sometimes revived when thawed out. That May-bugs can be restored to life after they have been drowned has been proved by Prof. Balbiani, of the Collége de France, in conclusive experiments. He restored many by drying them in the sun after he had kept them immersed for twenty-four hours, two days, and even five days. In another experiment a stag-beetle, put under alcohol for a half-hour and then dried, was still in motion after three days.

Going higher up in the animal series—eggs, which are analogous to the seeds of plants, present a remarkable example of retarded life. One of the most interesting features about them is the independence of their vitality, which persists even when the individual that has produced them, and within whose organism they are still contained, has ceased to live. This fact has been recognized in pisciculture, where artificial fecundation has been successful with eggs taken from dead fish.

The persistence of life in frogs is very long. Spallanzani preserved some frogs in a mass of snow for two years. They became dry, stiff, and almost friable, but a gradual heat brought them back to life. Vulpian observed a return of life in frogs and salamanders that had been poisoned with curare and nicotine. In both cases the animals in question had been for several days in the condition of cadavers. Toads have been shut up in blocks of plaster, and then, having been deprived of all air except what may penetrate through the material, and of all sources of food, resuscitated several years afterward. This question presents one of the most curious problems that biological science has been called on to explain. The longevity and vital resistance of toads are surprising. Besides the experiments we have cited, Nature sometimes presents some already made, and vastly more astonishing. Toads are said to have been found in rocks. Such cases are rare, but it would be as unreasonable to doubt them as to believe in some of the miraculous explanations that have been made of the matter. The phenomenon is marvelous, it is true, but it is supported by evidence that we are not able to contest; and skepticism, which is incompatible with science, will have to disappear if rigorous observation shall confirm it. The toad was observed, in one case, in the stone itself, and before, recovering from its long lethargy, it had made any motion. One of these toads was presented to an academy, with the stone which had served it as a coffin or habitation, and it was ascertained that the cavity seemed to correspond exactly with the dimensions and form of the animal. It is remarkable that these toad-stones are very hard and not at all porous, and show no signs of fissure. The mind, completely baffled in the presence of the fact, is equally embarrassed to explain how the toad could live in its singular prison and how it became shut up there. The strangest ideas have been expressed on this point. The ridiculous hypothesis has even been proposed of an imperceptible toad-germ that was developed in the interior of the stone. The fact of the survival of the toad, despite the impenetrability of the stone, becomes less doubtful when we recollect the similar experiments on animals inclosed in plaster, which we have mentioned above. But the problem of the toad's introduction into the stone still remains unsolved.

M. Charles Richet had occasion to study this question some months ago, and came to the conclusion that the fact was real, observing that even if, in the actual condition of science, certain phenomena were still inexplicable, we were not warranted in denying their existence, for new discoveries might at any time furnish an explanation of them. "The true may sometimes not be probable." But science takes accounting of the truth, not of the probability.

Hibernating mammalia are capable of putting on all the appearance of death. The marmot, during its lethargic sleep, is cold, the temperature of its body being hardly 1° C. above that without. It respires only three times a minute; and the beatings of the heart, which rise to ninety a minute in the active life of the animal, fall to ten in a minute. Bats, during the cold season, hang like dead bodies. One may take them in his hands, press them, and throw them into the air, without their manifesting any sign of feeling.—*Translated for the Popular Science Monthly from La Monde de la Science et de l'Industrie.*

SKETCH OF ROBERT KOCH.

ONE of the most eminent of the colaborers of Pasteur in the investigation of the relations of micro-organisms to disease-infection, and one whose labors have been most fully appreciated by intelligent men, is Dr. ROBERT KOCH, of Berlin. He was born at Clausthal on the 11th of December, 1843, the son of a high officer in the department of mines. He attended the gymnasium in his native town, and afterward—from 1862 to 1866—studied medicine at Göttingen. He became an assistant in the Allgemeine Krankenhaus, or General Hospital, at Hamburg; began the practice of medicine in 1866 at Langenhagen in Hanover; then settled at Racknitz, in Posen. From 1872 till 1880 he was *physikus* or district physician at Wallstein, in the district of Bomst. He engaged in studies of bacteriological diseases, including wound-infections, septicæmia, and anthrax, or splenic fever, with great success; and was appointed in 1880 a member in ordinary of the Imperial Health Office. In 1885 he was appointed a professor, and the director of the Hygienic Institute in Berlin.

The first public report of Dr. Koch's to attract general attention was that in reference to the bacterium which had been found associated with anthrax, or splenic disease, and was made about 1878. His investigations went to show that the potency of this organism lay in the spores rather than in the developed bacterium. He found that, when no spores were visible in the dried diseased blood with which mice were inoculated, the power of conveying infection lasted only for a few weeks; while blood in which the spores had separated continued virulent for at least four years.

He next turned his attention to those infectious disorders which originate in the introduction of poisonous matter through wounds. Living organisms had already been observed in these diseases, but their connection with the development of the infection had not been determined. Dr. Koch's experiments with small animals showed that different forms of disease were produced by the injection of putrid blood, one of which was not accompanied by the development of bacteria, but seemed due to a special poison which he named *septin* or *sepsin*, while another form was evidently bacterial; and that the effects varied with different animals.

In 1882 Dr. Koch published the results of experiments which went to confirm the opinion already held by physicians who had observed the progress of the discovery of the fungoid origin of various infections, that tubercular disease was also caused by microphytic germs. He claimed not only that he had ascertained the bacterial origin of the disease, but to have detected the specific microbe, having found a characteristic and previously unknown bacillus in all tubercularly altered organs. He had observed it in pulmonary tuberculosis, cheesy bronchitis and pneumonia, tubercles of the brain, intestinal tubercles, scrofulous glands, and fungous inflammation of the joints; in all cases which he had examined of spontaneous consumption in animals—in cattle, hogs, poultry, monkeys, porpoises, and rabbits. In monkeys dead of consumption he had found the organisms in quanities pervading the lungs, spleen, liver, diaphragm, and lymphatic glands. He supposed that, escaping into the air from the expectorations of phthisical patients, they were inhaled into the lungs, where they developed. Whenever the tubercular process was in its early and active stage, they were present in great numbers. When the climax of the tubercular eruption was passed, they decreased and might totally disappear.

Dr. Koch's report of this investigation was published in one of the Berlin medical journals, in a memoir on "The Etiology of Tuberculosis," of which Dr. Klein, a distinguished pathologist, said that any one who carefully reviewed it would "come to the conclusion that Dr. Koch's results are to be accepted with unconditional faith, and I have no manner of doubt will be considered by all pathologists as of the very highest importance. To those who are familiar with Dr. Koch's previous work, especially that on the etiology of splenic fever, or anthrax, and his observations on pathogenic bacteria, this last work of his, on the etiology of tuberculosis, will be an additional and brilliant testimony to his ingenious and successful method of research." This testimony is the more significant because Dr. Klein afterward disputed Koch's identification of the "comma bacillus" with the cause of cholera. In the next year a report was published by Mr. Watson Cheyne of a visit which he had made as a commissioner of the British Association for the Advancement of Medicine by Research, to the laboratory of Dr. Koch, and also to that of M. Toussaint, who was engaged in a similar investigation. It represented that such results of Toussaint as disagreed with those obtained by Dr. Koch were not borne out. But the result of inoculation with cultivations obtained from Dr. Koch was in all cases rapid development of tuberculosis. The examination of a large quantity of tuberculous material showed the constant presence of tubercle bacilli, but of no other micro-organisms. The rapidity and certainty of action of this matter, when inoculated into animals, was in direct ratio to the number of bacilli introduced, and the most certain and rapid means of inducing tuberculosis seemed to be the inoculation of the tubercle bacillus cultivated on solid blood-serum. These facts led Mr. Cheyne to the conclusion that these bacilli are the virus of the acute tuberculosis caused in animals by inoculation.

When the cholera broke out in Egypt in 1883, the German Government appointed Dr. Koch chief of a commission to go to that country, and also to India, for the purpose of watching the course of the epidemic and investigating the nature and cause of the disease. The report of the work of this commission in Egypt, published in the early autumn of 1883, while it did not make known any certain results of the investigation, and dealt "in a very guarded manner" with the question of the discovery of a definite cholera bacillus, pointed out the line on which future studies were to be pursued. In experiments carried on in both living and dead subjects, while no distinct organism could be traced in the blood and the organs which are most frequently the seat of micro-parasites, bacteria having distinct characteristics were found in the intestines and their mucous linings, under circumstances that seemed to identify them with the disease from [illegible] suffering. They were present in the case [illegible] from cholera, and in the bodies of all who [illegible] were absent in the case of one patient [illegible] from cholera, but had died of some [illegible] and they were not discoverable in the [illegible] during the cholera epidemic, succumbed to other diseases. They were also the same with the bacillus which Dr. Koch had [illegible] the year before in the bodies of patients who had died of cholera in India. From these causes the commission [illegible] justified in provisionally holding the belief that those bacilli were in some way related to cholera, but were not yet prepared to say whether they were the cause or the effect of the disease. In 1884 Dr. Koch visited Toulon, where cholera was raging, partly at the wish of the French Government, which desired to know more of his methods of investigating and suppressing the disease.

The investigations of the German commission were continued in India, and Dr. Koch's report on the subject was published in the "Klinische Wochenschrift," of Berlin, No. xxxiv, 1884. He had found, in the rice-water discharges of patients suffering from cholera, besides the micrococci and bacilli common to the evacuations of other patients, peculiar curved bacteria, which have become known as "comma-shaped" bacilli, such as he had not been able to discover in any cases of diarrhœa; and he had succeeded in isolating them by artificial culture. This he declared to be a specific micro-organism having marked characteristics distinguishing it from all other known organisms. These organisms grow rapidly in meat-infusion and blood-serum, and well in other fluids, especially milk, and in potatoes; and possess the power of active motion. They grow best at a temperature of between 30° and 40° C., and cease to grow at 16° C., but are not killed by freezing. They grow only in the presence of oxygen, and very fast; their vegetation rapidly reaches its highest point, then remains stationary for a time, after which it ceases as rapidly as it grew, and the bacilli die. When dried, they die within three hours; and they do not form spores. Micro-organisms possessing all of these and certain more delicate characteristics which are definitely described, are Koch's bacilli; organisms presenting only some of the characteristics, such as microscopical appearance, are something else.

The presence of these bacilli in cholera, which was represented as universal, was determined by microscopical examination in ten cases in Egypt, and by microscopical examination and cultivation in gelatinous meat-infusion in forty-two cases of *post-mortem* examination in India; and in numerous other cases of dejections in Egypt, India, and Toulon—giving a hundred cases occurring in various parts of the world, carefully examined, in which the organisms were found. It had been further found that this was the only form of micro-organism that was constantly present in the disease; that it was present in greatest numbers in acute and uncomplicated cases, and in the parts most affected; while it was never present in other diseases, in healthy persons, and had not been found outside of the body where no cholera was in the neighborhood. Then, having disposed of two hypothetical presumptions of contrary tenor, Dr. Koch declared that no other conclusion could be arrived at than that these bacilli are the cause of cholera.

Although no effects had then been obtained from experiments with comma bacillus upon animals, and direct experiments upon man could not be performed, various observations confirming the theory had been obtained which were almost as good as experiments on man. In the water of a tank whence the inhabitants of a village near Calcutta derived their supplies for drinking, cholera bacilli were found in considerable numbers when the cholera epidemic was at its height. At a later period, when there were only a few cases of illness, the comma bacilli were few in number, and found only at one part of the tank. This was the only instance in which these bacilli were found outside of the body. Finally, Dr. Koch maintained that the natural history of the disease corresponds with the various characteristics of the organism in question The bacilli grow rapidly, soon reach their highest point of development, then die, in correspondence with what occurs in the intestinal canal. Under ordinary circumstances the bacilli are destroyed in the healthy stomach, while persons suffering already from some disorder of the stomach are most liable to be attacked with cholera. Lastly, the disease dies out in places where the conditions for its continuance are unfavorable; as bacilli that have no spores will speedily disappear. In experiments subsequent to this report, Dr. Koch succeeded in producing cholera by inoculation in some of the smaller animals.

Dr. Koch's conclusions were contested and some of his evidences were disputed by a French commission appointed to inquire into the causes of cholera; by certain English pathologists, including Dr. Klein and Dr. Lewis, of Netley; and were not fully supported by an English commission in India; but, while they may not yet have been fully accepted, they have not been overthrown, nor do they seem to have lost ground. A bill was unanimously passed by the German Parliament, in 1884, awarding a sum of 135,000 marks to Dr. Koch and his companions in this research.

The principal published works of Dr. Koch are "Etiology of Splenic Fever," 1876; "Researches on Diseases of Wound-Infections," 1878; "Inoculation for Splenic Fever," 1882; "Contributions to the Etiology of Tuberculosis," 1882; and contributions to the transactions of the German Imperial Health Bureau.

EDITOR'S TABLE.

EVERY-DAY SCIENCE.

IF, on the one hand, we have frequent cause for astonishment at the rapidity with which modern life is being transformed under the influence of scientific invention and discovery, we are, on the other, sometimes compelled to wonder at the extreme slowness with which certain useful and entirely practicable reforms, plainly indicated by acknowledged scientific principles, are adopted by the public. There is a law in these matters which has perhaps never been very clearly formulated, but which it would certainly be desirable to understand. The telephone makes its way everywhere without pause or check, and the same is true of electric lighting and traction; while scientific cookery, though its general principles may be said to be fully established, lags painfully behind. That the latter is a matter of the utmost importance, economically and hygienically considered, needs no laborious demonstration; yet how to interest the public in it seems to be a most difficult problem. People who go wild over the New Jerusalem of "Looking Backward" listen with cold indifference when it is explained to them how they can introduce here and now a most important amelioration in their own lives by economizing at once their worldly substance and the wear and tear of their physical organs. The fact that the reform in question would be particularly beneficial to the so-called "working classes" fails to commend it to those who want a revolution or nothing. It is probably the case that men in general are more interested in spending than in saving, just as they have more admiration to bestow on a great warrior than on a great philanthropist; and that, consequently, inventions that represent and call for expenditure are more attractive than those which simply promote economy. More than one modern "improvement," we doubt not, has been adopted by many, as much from the pleasure of spending and—perhaps a more potent consideration still—of appearing to be able to spend the money required to procure it, as from a sense of its utility.

However this may be, and whatever the law may be which regulates public interest in the practical applications of science, there can be no doubt that reform in culinary operations is deserving of far more attention than it has hitherto received. As we showed last month, it deals with a prime—may we not say *the* prime ?—necessity of human life. It undertakes to substitute for a wasteful and hurtful empiricism in diet a scientific, economical, and wholesome method of preparing food for consumption. It shows us how we may save our pockets, how we may save our tissues, how we may lengthen our lives, and how we may increase our enjoyments. It promises to improve our tempers by decreasing the internal friction of our physical systems; and, of course, decrease of internal friction means increase in our efficiency for all good purposes. Unlike some reforms that exist only on paper, and that attract sentimental people for the very reason that they are never likely to have more than a paper basis, this particular reform has been tried and realized. Its results are known and can be exhibited at any moment. What is now required is that people should be persuaded that the thing is worth doing, and should be roused to shake off that lazy love of established routine which alone stands in the way of their doing it. The ordinary cooking-stove has so long been a kind of domestic Joss that its worship is hard to overthrow. That it is not a purely beneficent divinity many a sweltering attendant and many a dyspeptic partaker at the altar are prepared to attest; but pure beneficence, as every one knows, is not a quality that votaries always exact of their deities. Thus, just as long ago, at Ephesus, there were shrine-makers who stoutly withstood the new-fangled ideas broached by Paul, so to-day there are shrine-makers—i. e., stove-makers—who can not be expected to take very kindly to the ideas of our modern apostles of scientific cookery. We can not blame them if they are not in a hurry to break their molds and send their castings to the junk-shop; but, all the same, a reform so deeply founded in common sense must come in time, and it would be well to prepare for its coming by gradually approximating to the type of cooking apparatus required.

It is not in the matter of cookery alone that science is prepared to lend a helping hand in every-day life. There are a hundred reforms remaining to be accomplished, each one of which would do something to make our lives more worthy of rational beings. The most important and beneficent ones are those that can only be wrought by the earnest co-operation of each individual. What we have to do is to see that a duty lies in making the most of our knowledge; and it can nowhere be caused to yield a larger return than in its application to those ordinary affairs of life with which all are concerned.

A COMPARISON IN RACIAL DEVELOPMENTS.

Colonel Garrick Mallery's address on "Israelite and Indian," which is concluded in this number of the "Monthly," presents an unusually lucid and interesting study in comparative civilization and religion. The author's purpose in selecting these two particular peoples for comparison is, as he declares in the beginning, not because there is any special resemblance between them more than between any two other peoples at corresponding stages of civilization, but because they offer convenient types illustrative of a general principle. We are familiar with both—with the Israelites, through the universal habitual study of the Bible; and with the Indians, by virtue of our historical intercourse with them; and the illustrative incidents do not have to be explained, as they would be in the case of any other two peoples that might have been selected. The principle, which has been reached by anthropologists and students of religion generally, and is admitted by many eminent theologians—that religion is a thing of growth, and subject to continual development and refinement, and keeping pace with the advance of each nation in civilization and knowledge—is well set forth in the examples cited. The article bears the marks throughout that the author has studied the subject carefully and to the bottom. On the Israelite side he displays a critical knowledge of the Bible and the environment within which it was composed; besides which, he has brought to bear upon his argument the results of the investigations of that band of eminent scholars whose conclusions, under the name of the "higher criticism," have deeply moved the theological world. On the Indian side, he is at home in his own special field of research. Taking the two peoples at those periods in their history when they had reached nearly equivalent stages in civilization, he holds up the parallelisms in their religious opinions, particularly their ideas of God and a future state, their myths and their social usages, which, he assumes, were not peculiar to them, but could be found also among other bodies of people in the same stages of culture. That similar parallelisms are to be found among other nations of like civilization is a fact familiar to students of Oriental archæology.

The weight of interest will center upon Colonel Mallery's demonstration that the Israelites, at the period under examination, were polytheists. The interest is heightened by the appearance, in the "Jewish Quarterly Review" (London) for October, 1889, of a learned and exhaustive article by the Rev. Prof. A. H. Sayce, under the title "Polytheism in Primitive Israel," which comes to the same conclusion. Most of the points mentioned by Colonel Mallery in this regard are also brought out by Prof. Sayce, of course independently and with much greater elaboration. Some of his more striking passages may be quoted. He speaks of "the Israelites who first ventured to use the plural Elohim of their national God," and adds: "The fact that the Israelites never forgot that it [Elohim] was a plural term, that up to the last they often employed it in a plural sense, proves that the earliest users of it were worshipers of many deities. . . . We may gather from the history of Micah, in Judges xviii, that the worship of the teraphim was the necessary accompaniment of the tribal worship of Yahveh, as represented by a 'carved image,' and in the case of the tribe of Dan, at all events, it lasted 'until the day of the captivity.' . . . Yahveh was not yet conceived of as the sole god. . . . It was in Judah that the older cult first died out of the popular belief. After the division of the kingdom, Judah with its central capital at Jerusalem formed a compact and organized community, in which the earlier tribal distinctions which had marked it off from Simeon, or Dan and Benjamin, were soon obliterated. The dynasty of David welded the community together, and the Temple of Solomon became more and more the center of the common faith. The worship that was carried on in it, the belief of which it was the outward expression, the religious teaching and influence which emanated from it, gradually affected the ideas and convictions of the Jewish people. A time came at length when Josiah could venture to destroy the 'high places' where the old local cults had been carried on for unnumbered generations, and order his subjects to 'worship before the altar' at Jerusalem alone." Prof. Sayce also denies that the Semites were fundamentally monotheistic.

This publication by one of the most learned of living Oriental scholars, who is a professor in the University of Oxford and a clergyman of the Church of England, is important as corroborating the statements of fact from which Colonel Mallery has drawn anthropologic lessons.

LITERARY NOTICES.

SCIENTIFIC PAPERS OF ASA GRAY. Selected by CHARLES SPRAGUE SARGENT. Boston and New York: Houghton, Mifflin & Co. 2 vols. Pp. 397 and 503. Price, $3 each.

THE literary value of the papers contained in these volumes is equal to their scientific value, and that is well understood. Botanical criticism and description are not usually classed among literary subjects, but Prof. Gray made them one; and a large proportion of what he has written in that field is æsthetically enjoyable. The period of his scientific writing lasted fifty-three years—from 1834 to 1887—and during that time he made a remarkable number and variety of contributions, all stamped with evidence of thoroughness and the complete familiarity with his subject that seem to have been habitual with him. His writings are grouped by Mr. Sargent in four divisions. The first in importance contains his contributions to descriptive botany, relating chiefly to the flora of North America; "and although," says the editor, "it did not fall to his lot . . . to elaborate any one of the great families of plants, the extent and character of his contributions to systematic botany will place his name among those of the masters of the science." Next in importance are his educational works, manuals or text-books, the influence of which on the development of botanical knowledge in this country has been great. The third group includes a series of critical reviews of important scientific publications, and of historical accounts of the lives and labors of workers in botany; and the fourth group a number of papers which owe their existence to the discussions that followed the publication of Darwin's "Origin of Species." The present volumes contain a selection of papers from the third group, with a few essays on subjects of general interest to botanists. Most of these papers, unlike those of the other groups, which are still in the market, have long been out of print, and have not been incorporated in any recent publication. The selections have been made with the thought of presenting, as far as might be, a view of the growth of botanical science during the fifty years through which the papers run—a period which, as the editor observes, is marked by the gradual change of ideas among naturalists upon the origin and fixity of species that has broadened the field of all biological investigation. The period was also characterized by a great increase and diffusion of the knowledge of botany in the United States, and by the growth of a body of earnest, energetic American botanists, who have not only given vigor to the study and inspired interest in it through all the schools, but have also contributed to exalt the reputation of American science; and these botanists are, and are what they are, almost wholly by reason of what Prof. Gray and his books taught them.

A glimpse of the condition of botanical study in the United States at the beginning of Prof. Gray's fifty years is afforded in the first of the papers, which is a review of the second edition of Lindley's "Natural System of Botany," published in 1836–'37. The intimation that "we do not intend to engage in a defense of what is called the natural system of botany" indicates that that system had not yet fully conquered acceptance. Still, the author assumed that the science could by no other method be successfully and philosophically pursued, and added: "The few persons who remain at this day unconvinced of its advantages are not likely to be affected by any arguments that we could adduce. A somewhat larger number may perhaps be found in this country who admit the importance and utility of the natural arrangement in the abstract, but decline to avail themselves of the advantages it affords in the study of plants, because, forsooth, it is too much trouble to acquire the enlarged views of vegetable structure which are necessary for the application of its principles." But the system had grown in favor during the preceding six years. Twenty years later, in the review of Henfrey's "Botany," 1857, we are given this picture of the condition of botanical instruction here: "While in England botany is scarcely an academical study, here it pertains to collegiate and academical instruction where it is taught at all. In Europe not even an apothecary can be licensed without passing an examination in botany; in the United States, we believe, it forms no part, at least no regular part, of the medical curriculum; no medical school has a botanical chair; and no knowledge whatever of the science of the vegetable kingdom, which supplies the *materia medica*, is required for the degree of Doctor in Medicine!" With botanical chairs in a large number of our leading universities and schools, filled by experts who are engaged in original work and encourage it in their students; and pupils in high schools knowing more of the structure and qualities of plants than the doctors Prof. Gray describes, we of the present time have no reason to be ashamed of the advance that has been made. From these almost elementary considerations, the reviews and essays follow the series of publications in the science and the course of discussion over the whole scientific world, while having an eye primarily to America, including such subjects as Van Mohl's observations of the cell; De Candolle's theories of variation and distribution and of the origin of cultivated plants, in reviewing which the author displays the sharpness of his discernment and the thoroughness of his knowledge regarding American plants; Radlkofer's and Henslow's studies in fertilization; the principles of nomenclature and the definition of species; several local floras and special studies, never forgetting those that are primarily of American interest; and those studies in which Prof. Gray so greatly supported and aided Darwin, relative to variation and the origin of species. In these notices, while some of them seem to bristle with technicalities and run to details, the technicalities and details are never all, and are seldom a prominent feature. A lesson of general application is to be drawn in each of them, and is drawn and presented with such directness and lucidity that even young students can comprehend it and be interested in it. The essays in the second volume are more extended discussions of special topics, among which are "The Longevity of Trees," "The Sequoia and its History," "Do Varieties wear out, or tend to wear out?" "Forest Geology and Archæology," "The Pertinacity and Predominance of Weeds," and two on the flora of North America. Many of these papers, as well as no small number of the "Reviews," had not Prof. Gray been so pre-eminently a man of science, might have established his reputation as a literary essayist of the first rank. In some of them the author co-operates with Heer and De Saporta, anticipating the chief publications of the latter author, in working out the theory of the arctic origin of the plants of the temperate zone. "Notes on a Botanical Excursion to the Mountains of North Carolina" is a letter to Hooker, recording the experiences and observations acquired in a visit to a region which was of peculiar interest at the time, and is equally so now, on account of the number and variety of rare plants to be found there. This excursion seems to have been an exception to the general course of Prof. Gray's life; for, in an address at the American Association meeting in 1872, on "The Sequoia and its History," when he had just visited a unique botanical region in California, he says that, so far as our country was concerned, he had been to a great extent a closet botanist, and had not before seen the Mississippi or set foot upon a prairie. Through all of these papers Prof. Gray's style is clear; he goes directly for the point; is judicially minded; always at home, searching in criticism; and sometimes, as when dealing with Mr. Ruskin or exposing an error of the authors on whom Henfrey relies, keen in sarcasm. And the editor's observation that "his reviews represented the opinion of a just and discriminating mind, thoroughly familiar with all sides of the question before it, critical rather than laudatory, loving the truth and its investigators, but the truth above everything else," is fully borne out.

Sixth Annual Report of the Bureau of Ethnology, 1884-'85. By J. W. Powell, Director. Washington: Government Printing-Office. Pp. lviii + 675.

It is impossible to examine one of these handsome volumes without being deeply impressed by the extent of the work that is being done and the interest of the store of information that is being secured by this bureau. The report of the director states that the field-work of the year comprised mound explorations by several assistants under the charge of Prof. Cyrus Thomas; researches in the ancient ruins of the Southwest by parties in charge of Mr. James Stevenson and Mr. Victor Mindeleff; linguistic field-work by Mrs. Erminnie A. Smith, Mr. H. W. Henshaw, Mr. A. S. Gatschet, Rev. J. Owen Dorsey, and Mr. Jeremiah Curtin. General ethnological investigations in the field were carried on by Dr. Washington Matthews, Dr. H. C. Yarrow, and Dr. W. J. Hoffman. Office work on sign-language and pictographs was continued by Colonel Garrick Mallery; on bibliography of North American languages, by Mr. James C. Pilling; on the myths and customs of the Zuñi, by Mr. Frank H. Cushing; on ceramics, by Mr. W. H. Holmes; on a historical atlas of Indian concessions, by Mr. Charles C. Royce; and by the explorers above mentioned, on their several specialties, when not engaged in field-work. The first of the papers accompanying the report is on "Ancient Art of the Province of Chiriqui, Colombia," by William H. Holmes, and is based on the large collection of archæologic material from the province in the National Museum. The paper contains a wealth of information in regard to the works of the ancient inhabitants of this interesting region, and its descriptions are assisted by 286 illustrations. A curious feature of the Chiriquian objects buried with the dead is that they appear to have been made for that purpose, and not for use by the living. Another paper by Mr. Holmes is "A Study of the Textile Art in its Relation to the Development of Form and Ornament." Mr. Holmes gives an instructive analysis of the forces and influences inherent in the textile art, the first lessons of which are order, uniformity, and symmetry. He discusses the influence of textile ornament upon other forms of art, such as architecture and sculpture, and also the manner in which intrinsic decorative elements are remodeled in accordance with the rules of textile combination. The paper is illustrated with 73 figures. Prof. Cyrus Thomas supplements his former publications on American palæographic literature with "Aids to the Study of the Maya Codices," embodying some original discoveries, and some explanations not already brought forward. Plates 50 to 58 of the Dresden Codex, and portions of other plates of the Dresden and other codices, are figured in the text. Rev. J. Owen Dorsey furnishes an account of a secret society of seven degrees, still existing among the Osage, in which the traditions of the people have been preserved. This is accompanied by two of these traditions in the original language, which he has succeeded in obtaining, together with an interlinear and a free translation of each, with explanatory remarks. An extended account of "The Central Eskimo" is contributed by Dr. Franz Boas, who spent a considerable time among these people in the region between Hudson and Baffin Bays. The scope of the paper includes the topography of the region, the distribution, tribal divisions, and numbers of the inhabitants, their habits and customs, their religious practices and beliefs, with translations of their myths and legends, and descriptions of their peculiar and ingenious weapons, implements, and utensils. Much work of previous explorers has also been incorporated with the original material in this account. The paper is illustrated with 156 figures and nine plates, two of the latter being folded maps and six representing Eskimo drawings or carvings. A feature of the paper is the notation of a number of Eskimo songs.

CATALOGUE OF CANADIAN PLANTS. Parts I to IV. By JOHN MACOUN, M. A., F. L. S., F. R. S. C., Naturalist to the Geological and Natural History Survey of Canada.

RECENT years have brought to the botany of North America few contributions more valuable than the "Catalogue of Canadian Plants," by Prof. Macoun. The entire work has been issued within the past six years, the first part appearing in 1883, the fourth in 1888, and only recently distributed; but these six years bear only small proportion to the actual amount of time the work has cost. Prof. Macoun gives us the labor of a life. For nearly forty years he has been an indefatigable explorer and systematist, pursuing his investigations from Newfoundland to Vancouver's, from the Lakes to the Arctic Circle. The plan of the work contemplates an exact enumeration of the vegetable life of the Dominion, but virtually the plants of all northern North America are included, Alaska and even Greenland not being forgotten. For this area not only is each species named, but for each, to the extent of present knowledge, is given its geographical range as well, its distribution, also its synonymy, and, in many cases, notes concerning habit and habitat. Facts of distribution are given with unusual exactness. For every plant each station is named and the name of the collector given, so that the catalogue is no mere check-list, but in so far an authentic geographical botany.

It were a pleasing task, did the limits of this review permit, to notice at length many of the interesting points which this catalogue brings to light. Each specialist will, of course, scan the field in search of his own particular favorites, but every one at all familiar with North American botany will enjoy tracing the distribution of some of our more common or interesting forms. The common quaking asp (*Populus tremuloides*), for example, occupies the whole Northwest, from Labrador to Alaska. The sundew (*Drosera rotundifolia*), common in New England, but a plant which many a Western botanist has vainly desired to see, is reported common from Newfoundland west to the Pacific, and north to the Arctic Sea. *Dodecatheon Meadia* likewise runs north and west, and shoots its dainty stars in far Alaska, while plumes of *Hordeum jubatum* wave on the banks of the Mackenzie and Yukon. Few trees cross the continent from east to west. The paper birch (*Betula papyrifera*) is one. With this may be named *Picea alba* and *Picea nigra*. These two spruces start together in Newfoundland and extend westward across the continent side by side, until the former is replaced in Columbia by *P. Engelmanii*, with which in the Athabascan region it seems to blend, while the latter (*P. nigra*) drifts northward, until it finally vanishes side by side with the paper birch hard by the waters of the northern sea. All the species that pass from east to west seem to be northern forms. *Lonicera involucrata*, however, crosses the continent from New Brunswick to the sea-level of the Pacific coast. Very few plants whose center of distribution is west of the Rocky Mountains appear in the flora of the East. *Pseudotsuga Douglasii* comes as far east as longitude 114°; *Pinus Murrayana*, longitude 110°; *Rubus nutkanus* reaches Sault Ste. Marie, and *Goodyera Menziesii* the shores of Lake Ontario.

Some species which in those northern regions bind the floras east and west will interest naturalists generally by reason of peculiarly isolated distribution. Thus, *Armeria vulgaris*, common on sea-shores around the entire North, is found in profusion on the summit of Mount Albert, Gaspé. *Vaccinium ovalifolium*, reported in the United States from a single locality on the south shore of Lake Superior, occurs at many stations in the far Northwest and also on the summit of Mount Albert. *Galium kamtschaticum*, another arctic species, occupies the same interesting locality. *Heliotropium curassavicum*, characteristic rather of our Southern flora, surprises us by appearing abundantly away north and west of the Saskatchewan.

Six parts will show this excellent catalogue complete. Of these, the four already published are devoted to phenogamous plants exclusively; Part V will present the ferns and mosses; while algæ and fungi are relegated to Part VI.

Handbook of Psychology; Senses and Intellect. By James Mark Baldwin, Ph. D., Professor in Lake Forest University. New York: Henry Holt & Co. 1889. 8vo. Pp. 343. Price, $2.25.

In this book the author displays a thorough acquaintance with the works of those writers on the subject whose general philosophical attitude is different from his own, and he often adopts their conclusions, freely recognizing their merits. The references show a wide acquaintance with psychological works in all languages, and are impartially made, with no discrimination in favor of either Trojan or Tyrian, the author evidently intending that the reader shall be made fully acquainted with the literature of the various topics treated. The work is that of a scholar, the style is good, and many special themes are well handled. This is particularly true of sensation, though the selection of the word *tone* to characterize the quality of sensation as pleasurable or painful does not seem to us felicitous. So also the chapter on illusions is an excellent presentation in condensed form of a class of very interesting mental phenomena.

But while the author makes good use of the results of scientific psychological study, his work is vitiated by an inability to get rid of the notion that Psychology must be made a servant of Theology. We are reminded by his book of Dr. McCosh's works, though Dr. Baldwin is much less anachronistic. The difficulty is the old heresy that the human mind has a special and higher faculty for seeing things invisible, by a rational or intuitional apprehension. The moment we apply the term *intuition* alike to presentative knowledge and to representative products—concepts, judgments, inferences—as does Dr. Baldwin, we destroy the fundamental psychological distinction, and make a jumble of mental science. This is what is always done by those who insist on a "reason" and on "rational intuitions."

We have yet to see any fairer or better handbooks of psychology than Prof. Bain's and Mr. James Sully's, and either of these we should certainly recommend in preference to the present work, which, spite of excellences, is essentially misleading by reason of errors mostly growing out of the above-mentioned confusion.

"The New Review." Edited by Archibald Gove. Monthly. London and New York: Longmans, Green & Co. Price, 15 cents a number, $1.75 a year.

This addition to the number of monthly reviews deserves to be classed with the best. The first number was that for June, 1889, and the issues that have already appeared have been filled with the contributions of able and well-known writers. Being an English magazine, of course it contains some articles that the American reader would skip as being of rather remote interest; but much of its contents knows no nationality, for instance, "After the Play," by Henry James, and "The Dying Drama," a reply by William

Archer; also "The Religion of Self-Respect," by Mrs. Lynn Linton; "A Month in Russia," by Lady Randolph Churchill; "Wrestling in Japan," by the Hon. George N. Curzon, M. P. Papers on General Boulanger, the French elections, and the German emperor are among the contents of the early numbers, and the scientific arts are represented by an article on "The Eiffel Tower," by M. Eiffel, and one on "Electric Lighting," by the Duke of Marlborough. English political problems, general sociological questions, literature, history, and biography are among the fields which "The New Review" has already entered, and Charles Bradlaugh, St. George Mivart, M. Flourens, and Andrew Lang are among the contributors not already mentioned. Its mechanical work is excellent.

Handy Lists of Technical Literature. Part I. Useful Arts in General, Products and Processes used in Manufacture, Technology, and Trades. Compiled by H. E. Haferkorn and Paul Heise. Milwaukee: National Publishing and Printing Company. Pp. 99. Price with Key, $1.25 paper; $1.50 cloth.

As one of the tools of the book trade, this series of lists can not fail to be of value. It furnishes information about a class of books, many of which are published and distributed through other than the well-known trade channels, and hence are not easily found. Part I, already issued, contains titles of books in English published since 1880 of the classes specified in its title, entered alphabetically under the author's name, or, if anonymous, under the first word of the title. Each title is numbered, and the names of subjects are inserted in the same list, with cross-references to the titles. References are given also to articles in cyclopædias and to parts of works treating of the various subjects. The size, price, and date of each book are given, and the publisher is indicated by an abbreviation. The key consists of a list of the publishers' names for which these abbreviations stand, with addresses, each followed by the list-numbers of the books mentioned which the publisher issues or keeps on sale. An appendix to the "Handy List" consists of a selection of books of the same class published before 1880, and still kept on publishers' and jobbers' lists. Other parts to be published will include lists on military and marine affairs, engineering, mining, fine arts, building, and miscellaneous subjects.

A Dictionary of Music and Musicians. Edited by George Grove. Appendix. London and New York: Macmillan & Co. Pp. 306. Price, $2.25.

The large demand for this elaborate work, which now appears in a complete form, with its steady increase from the beginning, in Europe and America, are accepted by the publishers as showing that on the whole the book has fulfilled the intentions with which it started. Shortcomings were to be expected, and may be found; but with all the allowance that need be made for them, the value of the work is exceedingly great, and is far more than an equivalent return for the cost. Many of the special articles are treatises in themselves, and the biographical notices give very satisfactory accounts of the lives and works of musical men of every class, with fullness proportionate, on the average, to the importance of the subject. The purpose of the appendix, which was promised from the beginning of the publication, is to supply omissions and correct errors in the original text, furnish new information, and bring the whole up to the latest practicable dates. It is arranged alphabetically, and forms a considerable volume in itself. A copious index of the whole four volumes will shortly be published in a separate volume.

"Bulletin, No. 36," of the United States National Museum, is *A Review of the Family Delphinidæ*, prepared by *Frederick W. True*, as a contribution to the natural history of the cetaceans. The publication is the forty-seventh of a series of papers intended to illustrate the collections of the National Museum. Previous to preparing the review, Mr. True visited the European museums, in order to examine the type specimens contained in them as an essential prelude to the proper comparison of species. He there also met several zoölogists, who furnished him information; among them, Prof. Flower, who placed in his hands the proof-sheets of his own work on "The Delphinidæ." The present work differs from Prof. Flower's in that it is directed to the determination of species, while the British author makes the discovery of mutual relations and associations into groups a prominent object.

The tenth volume of the *Resultados del Observatorio Nacional Argentino* at Cordoba, Juan M. Thome, director, contains all the observations made during 1877 for the General Catalogue, the four microscopes, as well as three tallies of transit-threads, having been employed for them; and the zones from 755 to 759 inclusive, with their reduction-tables, and an index for reference. The number of stellar determinations made during the year was 17,380, of which 516 were made in zones. Tables of corrigenda for the present volume, and for the errors detected in the volumes already published, are appended.

The paper of Mr. *Cyrus Thomas*, entitled *Aids to the Study of the Maya Codices* (Government Printing-Office), is based on the assumption that an attempt to decipher those documents on the supposition that they contain true alphabetic characters must end in failure. Some of the characters are more than probably phonetic symbols; but Landa's alphabet furnishes no help in deciphering them, and is evidently based on a misconception of the Maya graphic system. "If the manuscripts are ever deciphered, it must be by long and laborious comparisons and happy guesses." This paper is intended to be a step in that direction. The author concludes that, at the time the codices examined were written, "Maya culture had reached that stage where the idea of phoneticism was being introduced into the writing. Yet it is certain, and even susceptible of demonstration, that a large proportion, perhaps the majority, of the characters are symbols. The more I study these characters the stronger becomes the conviction that they have grown out of a pictographic system similar to that common among the Indians of North America. The first step in advance appears to have been to indicate, by characters, the gesture-sign."

In *Hints for Teachers of Physiology* (D. C. Heath & Co., "Guides for Science Teaching"), Prof. *H. P. Bowditch* makes an attempt to show how a teacher may supplement his text-book instruction by means of simple observations and experiments on living bodies or on organic material, so as to impart to his pupils a knowledge of the foundation on which physiology rests, and bring the impressions made on the senses to aid the memory in retaining the facts communicated didactically. The essay, though simply a primer, is fruitful in suggestions for familiar illustrations.

Though edible mushrooms of many varieties are found in all parts of the United States, few of them are utilized, because the majority of the people do not know how to distinguish them from poisonous species. A useful aid to making this very important distinction is furnished in Dr. *Thomas Taylor's* pamphlet of descriptions, with natural-colored illustrations, of *Twelve Edible Mushrooms of the United States*; which also gives directions for selecting and preparing for the table. The paper is embodied in the report of the Department of Agriculture for 1885, and is published separately by Dr. Taylor in Washington.

Investigations of sorghum-blight and the mildew of the huckleberry, with certain parasitic insects inhabiting the knots produced by it, and the fungous parasites of weeds, together with experiments in the cross-fertilization of corn and the germination of weed-seeds, are described in the *Report of the Botanical Department of the Kansas State Agricultural College Experiment Station*.

A number of documents and papers concerning the care of the insane, and questions concerning the responsibility of the insane, may be noticed in a group. The *Report of the Standing Committee on the Insane* of the New York *State Board of Charities* presents the results of the annual visitation to examine the condition of the eight State hospitals and asylums and the eighteen asylums of the exempted counties. *The Recent Judicial Departure in Insanity Cases*, by *Clark Bell*, reviews two recent decisions of high courts—one of the State of Alabama and the other of the United States—that indicate an approach to a more fixed and accurate definition of the responsibility of the insane than has heretofore prevailed. — In the case of *The Insanity of Oscar Hugo Webber*, Dr. *J. Hendrie Lloyd* enters a protest against the conviction for murder of a man who in the author's view was insane to irresponsibility.—The question of responsibility is brought more directly under view in Dr. *T. R. Buckham's* paper on the "*Right and Wrong" Test in Insanity*, in which it is maintained that the subject may be irresponsible, if acting under insane impulses, even if he is aware that the deed he is committing is wrong.—Mr. *A. Wood Renton*, discussing the question of *Testamentary Capacity in Mental Disease*, collates what the courts have defined as the law on that subject, maintains that the issue on that point should be narrowed, when it arises, to the question, "Was this man capable of making this particular will at the time of its execution?"

The Commonwealth is the name of a monthly magazine of 144 pages, published by the *Commonwealth Publishing Company*, Denver, Col., which in June, 1889, had reached its fourth number. Among several stories and miscellaneous articles, we find two or three relating to the early history of Colorado. Of such are "Glimpses of Early Days," describing the site and surroundings of Denver in 1856, before there was a town or house there; a relation of remarkable trials and executions by extemporized courts that took place in the primitive times of "thirty years ago"; and an account of the attempt to set up a Territory of Jefferson in 1859, while the region of Denver was still technically Arapahoe County, Kansas. The effect of a pungent paper, suggesting condemnation of the awkward attitudes into which religious newspapers sometimes place themselves with regard to politics, is neutralized by the editor's depreciation of civil-service reform.

Dr. *T. D. Crothers*, in a paper asking *Should Inebriates be punished by Death for Crime?* and Dr. *Joseph Parrish*, in *The Legal Responsibility of Inebriates*, argue against treating inebriate criminals as if they were responsible, and in favor of subjecting them to the same kind of treatment as is given to the insane.

Six additional numbers of the *Modern Science Essayist*, a monthly publication of lectures and essays on topics immediately related to evolution, invite attention. In the first of the group, No. 7, on "The Descent of Man," Prof. Cope traces the descent in lines not greatly different from those drawn by Prof. Topinard in a recent number of the "Monthly," and insists that man is still subject to the struggle for existence. In "The Evolution of Mind," Dr. R. G. Eccles argues that the elaborate mental functions of man have been gradually developed from the simplest beginnings. In "Evolution of Society," Mr. James A. Skilton treats society as an organism, capable of growth, of decrease as well as increase; of vitality, of disease as well as of health; and of death and decay as well as of life and growth—all by the operation of natural law. In "Evolution of Theology," Mr. Z. Sidney Sampson assumes that the tendency of the general movement of the theistic conception is along the same lines as in scientific thought, from narrower to wider generalization; following the natural order of the evolution of the mind, when free, from lower to higher ideals. In "Evolution of Ethics," Mr. Lewis G. Janes considers the individual as the chief concern, and the individual character as the supreme end, by the perfection of which only society can be perfected. In the twelfth number of the series, the "Proofs of Evolution" are summed up by Mr. Nelson C. Parshall as derivable from astronomy, geology, morphology, embryology, metamorphosis, rudimentary organs, geographical distribution, discovered links, artificial breeding, reversion, and mimicry.

Alphonse Daudet's *La Belle Nivernaise*, or the story of a river barge and its crew, has been selected by Prof. *James Boielle* as the "ideal" reading-book in French for the junior classes of high schools and the higher classes of preparatory schools. Having been written for the author's ten-year-old son, it is commended as a striking example of "a great intellect coming down to the level of a child of tender years, and telling in short, simple, and pithy sentences, pregnant in meaning, the story of the loving sympathy of the poor for their poorer and more defenseless brethren. The notes give clear definitions of idiomatic expressions, with explanations of etymologies and allusions. Ginn & Co.

Three numbers—7, 8, 9—of the seventh series of the Johns Hopkins University Studies in Historical and Political Science are occupied with a paper on *The River Towns* *of Connecticut*—Wethersfield, Hartford, and Windsor—by *Charles M. Andrews*. As in the other monographs of this series, the origin, growth, and development of these towns, with the various phases of social, political, and other life which they have passed through, are reviewed from the historical and philosophical point. The agrarian and civil life of the sturdy people who constituted their population, the author observes near the end of his story, "was not essentially different from that existent among the other New England towns; such life was in its general features everywhere the same. On close examination, however, we find that the machinery of town and court administration can be classified as to whether it is pure or mixed, simple or complicated, natural or artificial. To Connecticut belongs the best of these conditions. Her town life was pure, simple, and natural; the law which guided her political relations was nearer to the law which governs to-day than anywhere else on the American continent. We are apt to think of her settlement as an artificial importation, as one ready-made through the influence of pre-existent conditions. Beginning with the commercial stage, when trade was the motive power, it soon entered the agricultural stage, when the adventure lands were occupied by planters. With the development of this phase of its growth the military stage begins, when it became necessary to systematically arm against the Indians, and to turn the agricultural settlements into armed camps, with the people a body of trained soldiers. At this stage the ordinary religious life begins, when systematic church life arises with the infusion of new settlers; and last of all is reached the civil or political stage, when for the first time the settlements may be fairly called organized towns."

The Batrachia of North America, by Prof. *E. D. Cope*, is the forty-fifth of the series of papers illustrating the collections of the United States National Museum. The work embraces the results of a study of the character of the species, with their variations, for which the museum furnished liberal material, and studies of the osteology of the class, based on the material contained in various museums of the United States and Europe. The manuscript prepared several years ago by Prof. Baird and Dr. Girard has also been used, and ninety-one descriptions of species have been taken from it. The results have been expressed largely in systematic form, under the belief that descriptive zoölogy will never be complete until the structure is exhausted in furnishing definitions. Reference is made, wherever practicable, to the relations between the extinct and living forms. The general characters of the Batrachia, their general anatomy, larval characters, classification, affinities, and phylogeny, are considered, and terms and nomenclature explained, in the chapter introductory to the descriptions.

The *Annual Report of the State Geologist of New Jersey* for 1888 announces the completion of the magnetic and topographic surveys. The results have already been published and distributed in the first volume of the final report, recently noticed in the "Monthly." The second volume will contain full catalogues of the minerals, plants, and vertebrate and invertebrate animals, their occurrence and localities and some practical and economic particulars regarding them. The work still to be done in the matter of the geological structure of the rocks of the State consists mainly in combining and systematically arranging the materials which have been collected. A few points remain to be cleared up, and when this is done the volume on structural geology can be prepared, to be followed by one on economical geology. Among the material returns that have accrued to the State from the distribution of the reports are the system of artesian well-boring, which was started at the direct suggestion of the survey; increased attention to the development of the fire and potter's clay properties; drawing attention through the maps to many peculiar advantages of New Jersey; investments induced by the notices of mines, quarries, lime, marls, drained lands, and water supplies; and benefits to agricultural interests. The present report is brief, and includes "Geological Studies of the Triassic or Red Sandstone and Trap Rocks," with papers on drainage of the Pequest meadows and the low lands of the Passaic, water supply and artesian wells, and statistics of iron ores, zinc ores, fire clays, stoneware clays, and bricks.

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POPULAR MISCELLANY.

The Name Silurian in Geology.—We have received from Prof. Dana the following note in explanation of a change in geological nomenclature recently proposed by him:

"The names for the grander divisions of the Palæozoic series below the Devonian used in most of the recently published works on geology are Cambrian, Lower Silurian, and Upper Silurian. Cambrian was proposed by Sedgwick, and Silurian by Murchison, and both names are derived from the names of ancient tribes of Wales. In 1879 Dr. Lapworth proposed to substitute the term Ordovician, a term of like origin, for the Lower Silurian, and its adoption is under discussion. Although not seeing any need of further change, I urged, in my paper before the American Geological Society at Toronto, that the name Silurian, if it is to be restricted, should be used for the *Lower* Silurian rather than the Upper, on the ground that it was more just to Murchison and better for the science. I further added that for a new name for the Upper Silurian, rather than go again to Wales for one, we should consider the claims of Bohemia, the land where Barrande carried forward his great work on the Silurian and associated rocks, or to the region of New York and Canada, made famous geologically by the Palæozoic labors of Hall, Billings, and others. I stated that the French geologist, De Lapparent, had already used the name *Bohemian* for the Upper Silurian; and I then remarked that the lower portion of the Upper Silurian was called the Ontario Division in the Reports of 1842 and 1846 of the New York geologists, Profs. Mather and Emmons, and that this suggested the use of the name *Ontarian*. This would make the names for the three grand divisions referred to the Cambrian, Silurian, and Ontarian.

"JAMES D. DANA."

History in High and Preparatory Schools.—Two opposite demands, according to Mrs. Mary Sheldon Barnes, have to be met in teaching history in the high school; one for the generalities which are the commonplaces of every scholar, the other for fresh and independent study of historic detail from historic sources. As a solution of the difficulty thus raised, the author proposes teaching the general truth through the special fact, and making each pupil judge the special fact for itself in its general aspects. The first step in this direction should be to give the student a little collection of historic data, and extracts from contemporary sources, together with a few questions within his power to answer from these materials. "Then let him go by himself, like Agassiz's famous student with the fish, to see what he can see." The prominent characteristics of the method employed by Prof. I. B. Burgess, of Newport, R. I., for teaching classical history preparatory to college, are, almost exclusive attention to the facts which are essential to the comprehension of Greek and Roman life and its development; the study of primitive facts, such as maps, pictures of Greek and Roman works; speeches and writings of Greeks and Romans; and the use of questions about these facts, which require not the simple repetition of them, but the gathering and comparison of different facts, and the drawing of inferences from them by the pupil himself.

An Unsettled Part of Minnesota.—The report of the Geological and Natural History Survey of Minnesota for 1887 consists most largely of local details, of interest chiefly to the specialist. The work was prosecuted by three parties, two of them operating in the region of the original Huronian and the iron-bearing rocks of northern Michigan and Wisconsin, and the third in the region of Rainy Lake, while briefer surveys were made in other regions. Prof. N. H. Winchell's examination of the original Huronian leads to some important results which have a direct bearing on the classification of the rocks of Minnesota and of the Northwest. Prof. Alexander Winchell describes the Huronian region as traversed from east to west by a low, interrupted swell, called the Giant's Range, and by another series of still higher reliefs called the Mesabi Range—which must, however, be distinguished from another Mesabi Range—but without conspicuous features of mountain relief. As a rule, the surface is rugged and uncultivable. Between Fall Lake and Grand Portage, and north of Grand Marais, the region is "a literal wilderness without inhabitant, without mails, without roads, and with only an occasional party of Indians or explorers, following the ancient and overgrown trails of two centuries ago." Fires have denuded the region of its primitive forests; but the older burnings are becoming overgrown with thickets of aspen, white paper birch, cherry, etc. A few remnants of the original forest are occasionally found; and various shrubs and low herbs occur. Many small tracts of deep and productive soil intervene between the almost universal rocky or thinly covered exposures. The summer climate was agreeable, with sunny days as the rule during two seasons. No experience was had of the winter climate. The character of the country covered by Mr. H. V. Winchell's Rainy Lake survey varies greatly in different regions. In the vicinity of Rainy and the neighboring lakes, it is very rocky, while west of these lakes the surface consists of drift deposits, and the underlying rock appears only at rapids and waterfalls in the streams and a few places in the midst of the forest. The region within the limits of the glacial lake Agassiz is now covered with a fine growth of timber, both hard and soft wood, and is excellent farming land.

Old Cyclopædias.—The most extensive, and one of the oldest of cyclopædias is the Chinese work, the name of which may be translated as the "Thesaurus of Writings Ancient and Modern," compiled under the scholarly Emperor Kang Hi, which was printed toward the close of the last century. It was the fruit of forty years of labor, and filled 5,020 volumes; but this by no means implies that it was as large as a European book of that number of volumes would be. Pliny's "Natural History" may be regarded as the oldest European encyclopædia. The "Speculum Majus" of Vincent de Beauvais, in the thirteenth century, was divided into 10,000 chapters, several of which were subdivided alphabetically. About a hundred years later came the "De Proprietatibus Rerum" of the English Franciscan Bartholomew de Glanville, which was translated into the English of the day. Johann Alsted's "Encyclopædia" (1630) was one of the first works that bore the name. The anonymous "Universal Historical Geographical, Chronological, and Classical Dictionary" (1703), a nearly forgotten work, is said to be "full, concise, lively, and, all things considered, wonderfully accurate," but some very funny statements made in it are pointed out. In the next year was published Dr. Harris's "Lexicon Technicum, or an Universal Dictionary of Arts and Sciences," which has been given the credit, that of right belongs to the preceding work, of being the first alphabetical encyclopædia written in English. Next to these works follow the generation of cyclopædias which are still known among us, beginning with Ephraim Chambers's Cyclopædia (1728) and D'Alembert and Diderot's great work, and coming down to the new edition of the "Britannica," Stephen's "Dictionary of National Biography," and Appletons' "American Cyclopædia" and their "Cyclopædia of American Biography."

The Ice-Cap of Greenland.—Dr. Frithiof Nansen showed, in the British Association, in opposition to Nordenskiöld's opinion, that the part of Greenland which his expedition had traversed is covered with a shell-shaped mantle of ice and snow, under which mountains, as well as valleys, have quite disappeared, and where the configuration of the land and mountains can not be traced. The ice covering rises rather regularly but rapidly from the east coast to a height of nine or ten thousand feet, is rather flat and even in the middle, and falls off again regularly toward the west coast. There must be mountains and valleys in the interior of Greenland as well as on the coast. It is already known that there are on the coasts deep fiords and lofty mountains very like those of western Norway, and that they have in some places just the same wild and prominent character. If we entertain the opinion that these fiords were excavated by the ice, we must also conclude that the same ice has been able to excavate valleys and form mountains in the interior of the continent. We have no right, therefore, to seek the reason of the shield-like shape of the ice in the configuration of the land underneath its surface. It must have a shape of its own, which was given, not by the land, but by the meteorological circumstances. Nobody could deny that the ice might in some places have an enormous thickness, as it filled the valleys and covered up all the mountains. The thickness must be regulated by the quantity of snow falling, and this is largest toward the coast, gradually diminishing toward the interior. Hence the thickness of the ice would be greatest on both sides toward the coast, just as has been observed. The surface of the snow-field in the interior is even and as if polished, resembling the undisturbed surface of a frozen sea, the long but not high billows of which, rolling from east to west, are not easily distinguishable to the eye. The principal factor in giving the surface this shape is the wind. A careful observation of a snow and ice covering like that of Greenland is of great importance for the theory of the formation of valleys and fiords. It seems that the more we study Greenland, its coasts, and its inland ice, the more convinced we must feel of the power of the ice to perform this work.

The Bruce Photographic Telescope.—The Astronomical Observatory of Harvard College has received from Miss C. W. Bruce a gift of fifty thousand dollars for the construction of a photographic telescope such as the director had described in his circular of November 28, 1888, as desirable. The instrument will have an objective of about twenty-four inches aperture, and a focal length of about eleven feet. It will differ from other large telescopes in the construction of its object-glass, which will be a compound lens of the form used by photographers and known as the portrait lens. The focal length of such a lens is very small compared with its diameter, and much fainter stars can be photographed in consequence. The advantage is even greater in photographing nebulæ or other faint surfaces. Moreover, this form of lens will enable each photographic plate to cover an area several times as great as that which is covered by an instrument of the usual form. The time required to photograph the entire sky is reduced in the same proportion. A telescope of the proposed form, having an aperture of eight inches, has been in constant use in Cambridge for the last four years, and is now in Peru photographing the southern stars. It has proved useful for a great variety of researches. Stars have been photographed with it too faint to be visible in the fifteen-inch refractor of the observatory. Its short focal length enables it to photograph as faint stars as any which can be taken with an excellent photographic telescope having an aperture of thirteen inches. The eight-inch telescope will photograph stars about two magnitudes fainter than can be taken with a similar instrument having an aperture of four inches. A corresponding advantage is expected from the increase of the aperture to twenty-four inches. Other advantages to be anticipated from the use of such an instrument will arise from the opportunities which the photographs will give for continuous and detailed study. With them work can be done at any place and any time, and, by multiplying copies, by any number of observers. And with them more could be added by a single lens to our knowledge of the stars than could be obtained by any number of telescopes of the usual kind. Prof. Pickering is seeking the best possible location at which to mount the instrument. Owing to the difficulty in maintaining regular observations in the Eastern States that arise from the prevalence of cloudiness, he suggests one of the mountains of southern California as likely to offer the most favorable climatic conditions attainable.

What it takes to play a Piece of Music.—Science, says Sir James Paget, will supply the natural man with wonders uncounted. The author had once heard Mlle. Janotha play a presto by Mendelssohn. She played 5,595 notes in four minutes and three seconds. Every one of these notes involved certain movements of a finger, at least two, and many of them involved an additional movement laterally as well as those up and down. They also involved repeated movements of the wrists, elbows, and arms, altogether probably not less than one movement for each note. Therefore there were three distinct movements for each note. As there were twenty-four notes per second, and each of these notes involved three distinct musical movements, that amounted to seventy-two movements in each second. Moreover, each of those notes was determined by the will to a chosen place, with a certain force, at a certain time, and with a certain duration. Therefore there were four distinct qualities in each of the seventy-two movements in each second. Such were the transmissions outward. And all those were conditional on consciousness of the position of each hand and each finger before it was moved, and, while moving it, of the sound and the force of each touch. Therefore there were three conscious sensations for every note. There were seventy-two transmissions per second, one hundred and forty-four to and fro, and those with constant change of quality. And then, added to that, all the time the memory was remembering each note in its due time and place, and was exercised in the comparison of it with others that came before. So that it would be fair to say that there were not less than two hundred transmissions of nerve force to and from the brain outward and inward every second, and during the whole of that time judgment was being exercised as to whether the music was being played better or worse than before, and the mind was conscious of some of the emotions which the music was intended to inspire.

Ancient Chaldean and Modern Measures.—According to Prof. Harkness, in his presidential address to the Philosophical Society of Washington, the ancient Chaldeans used, primarily, the decimal system of notation, and also the duodecimal in the division of the year and of the day into hours, and the sexagesimal in the division of the circle and of the hour and minute. The last two systems were also applied to weights and measures, and impressed upon them by the scientific authority of those ancient sages. "Now observe," says the author, "how the scientific thought of to-day repeats the scientific thought of four thousand years ago. These old Chaldeans took from the human body what they regarded as a suitable unit of length, and for their unit of mass they adopted a cube of water bearing simple relations to their unit of length. Four thousand years later, when these simple relations had been forgotten and impaired, some of the most eminent scientists of the last century again undertook the task of constructing a system of weights and measures. With them the duodecimal and sexagesimal systems were out of favor, while the decimal system was highly fashionable, and for that reason they subdivided their units decimally; but they reverted to the old Chaldean device for obtaining simple relations between their units of length and mass, and to that fact alone the French metric system owes its survival. Every one now knows that the metre is not the ten-millionth part of a quadrant of the earth's meridian, and in mathematical physics, where the numbers are so complicated that they can only be dealt with by the aid of logarithms, and the constant π, an utterly irrational quantity, crops up in almost every integral, mere decimal subdivision of the units counts for very little. But in some departments of science, as, for example, chemistry, a simple relation between the unit of length (which determines volume), the unit of mass, and the unit of specific gravity, is of prime importance; and wherever that is the case the metric system will be used. To engineers such relations are of small moment, and, consequently, among English-speaking engineers, the metric system is making no progress, while, on the other hand, the chemists have eagerly adopted it. As the English yard and pound are the direct descendants of the Chaldean-Babylonian natural cubit and mina, it is not surprising that the yard should be only 0·48 of an inch shorter than the double cubit, and the avoirdupois pound only 665 grains lighter than the Babylonian commercial mina; but, considering the origin of the metric system, it is rather curious that the metre is only 1·97 inches shorter than the Chaldean double royal cubit, and the kilogramme only 102 grains heavier than the Babylonian royal mina. Thus, without much exaggeration, we may regard the present English and French fundamental units of length and mass as representing respectively the commercial and royal units of length and mass of the Chaldeans of four thousand years ago."

Mount Roraima.—Mount Roraima, that sharply perpendicular elevation in Guiana which so long defied attempts to reach its summit, has been ascended twice since it was first conquered by Mr. Im Thurn in 1884—by Mr. F. Dressel and Mr. Cromer, in October and November, 1886. While Mr. Im Thurn's ascent took place at the beginning of the rainy season, Mr. Dressel's was in the dry season, and their respective observations were marked by corresponding differences.

Mr. Im Thurn had observed no animal life while he was upon the mountain; Mr. Dressel saw a few butterflies, all of a dark-brown and nearly black color. In the shallow basins a few specimens of a small black toad with a yellow spot on the throat were found. A third animal form was noticed in the moist earth attached to some plants which had been pulled up—a milliped. The fantastic shapes into which the sandstones have been formed, and the calmness of the scene, affected Mr. Dressel as they had Mr. Im Thurn.

Experience and Training in Mechanical Work.—To be a good mechanic, said Sir Benjamin Browne, at the recent meeting of the British Association, long training is necessary; and, above all, ability to distinguish good work from inferior work. A regular course of progress from one branch to another should be carefully followed, so as to teach every class of work up to the most difficult. In this the real interest of the employer is the same as that of the lad, viz., to learn every step thoroughly, and then pass on to something more difficult. The author contended that a long training in a manufactory is absolutely necessary, and this should be supplemented by theoretical and technical instruction. It would probably be a great gain to give a lad six or eight months of theoretical teaching after he is out of his apprenticeship. The old-fashioned system of apprenticeship, not much shortened, and with very slight modifications, is the only reliable method for either employer or mechanic to learn his business; but, as work has become more scientific and elaborate, it is necessary for any young man who wishes to excel to have a good theoretical and technical training in addition to his factory experience.

How Stone Implements were made.—Mr. Gerard Fowke, of Sidney, Ohio, has been studying the manner in which primitive man made his stone implements. Although the subject is one on which absolute knowledge can never be obtained, he has been able to reach some definite conclusions on it. Some of the material was obtained from extensive quarries in Coshocton County, and between Newark and Zanesville, Ohio, where the hills are seamed for miles with the trenches and pits left by the ancient diggers. To get the flint, the overlying stratum of earth, nine or ten feet thick, had to be removed, with wooden tools. The rock was then cracked by building a fire, and probably pouring water upon it, the process being repeated till the limestone was reached and a hole made large enough to work in. Other cracks were made by building a fire at the lower part of the ledge, and the split rock was detached. This work was sometimes carried on for several hundred yards. The stones were reduced to blocks of suitable size by stone hammers weighing, perhaps, two hundred pounds, and the shaping was carried on with hammers running, according to its stage and the quality of work desired, down to two ounces in weight. The finished object was smoothed and sharpened by rubbing it with sandstones. If a hole was wanted, it was drilled with a stick, cane-stem, piece of bone or horn, flint, or piece of sandstone, which was revolved in the hands, or twisted back and forth with the bowstring. This was not a speedy process. Dr. Rau worked at it experimentally for two years, and left his first hole not bored through. Yet some of the Amazon tribes spend the lifetimes of two men in drilling, with the flexible shoot of a wild plantain and sand and water, the bores of their tubes of rock crystal. Handles were fitted on in a rude way and secured by wrapping with sinew, which shrunk and bound them tightly; or, with the aid of gum. The fashioning of arrow-heads was a very delicate and curious work, requiring skillful manipulation, and was performed with stone hammers or chisel-points of deer-horn or wood.

Bellite.—The new explosive, bellite, was recently subjected in England to some very satisfactory tests of its safety and power. Letting a great weight fall upon cartridges composed of it, they were simply crushed into a hard mass. But when the crushed cartridges were afterward detonated by means of a fulminate, immense energy was developed. Again, when placed in the fire of a smith's forge, it was volatilized. The effect of exploding a three-ounce cartridge on the lid of a case containing bellite was simply to pulverize the wooden case and scatter the contents. Comparative experiments showed that, when bellite was confined, the energy developed on detonation was equal to that of dynamite; but that when unconfined, bellite apparently did less work. In mine-blasting bellite was proved capable of doing the work of three or four times its weight of gunpowder, without the fumes that rise when dynamite or gunpowder is used.

Distribution of Rotifera.—Of the little animals classified as *Rotiferæ*, the most species have been found in Great Britain—not certainly because they are more abundant or varied in England than elsewhere, but because they have been more industriously looked for, and more found there. In late years, two and a half times as many species have been added to the British lists as to those of all other countries put together. There are curiosities in the distribution of these animals. Twenty-four out of the recorded species in Australia are also British; and of the remaining species, one has a habitat in the United States. The same phenomena occur, though on a reduced scale, in the United States, Jamaica, and Ceylon. The question arises, How could these minute creatures, which are inhabitants of lakes, ponds, ditches, and sea-shore pools, contrive to spread themselves over the whole earth? A species which is known only in a small duck-pond in England has also been found at Sydney. Another species has been found almost simultaneously at Sydney and in Ontario. These creatures, "to whom a yard of sea-water is as impassable a barrier as a thousand miles of ocean," could only have reached distant countries in the egg; this they do by the hardy ephippial egg. These eggs fall to the bottom of the water in shallow pools, or are attached to the confervoid growth on the stones. The pool dries up, is swept by the winds, and the eggs are lifted up and carried away. There is hardly any limit to the distances to which they may be thus taken and yet keep vital. Then, as Dr. C. T. Hudson shows in his paper on this subject, "the eggs, of course, must often fall on unsuitable places, and be carried past suitable ones, and this accounts for the capricious appearance of *Rotifera* in some well-watched ponds, and for the frequent disappointment of the naturalists who visit such spots. To this aërial carriage of the eggs is also due the perplexing fact that when any rare *Rotifera* is found in one spot, it is frequently found at the same time in closely neighboring ponds and ditches, even in such an unlikely hole as the print of a cow's foot filled with rain, but not at all in more promising place, at some distance off." They may also be distributed by water-birds and dogs. The animals themselves are very hardy against heat and dryness. The *Philadinadæ*, when time is given them to don their protective coats, can bear a heat gradually advancing to 200° Fahr., or a fifty days' exposure to a dryness produced over sulphuric acid in the receiver of an air-pump.

The City of the Cat-Goddess.—M. Edouard Naville recently gave before the Victoria Institute an account of his important discoveries at Bubastis, one of the ancient great cities of the Delta of Egypt, and the principal seat of the worship of the cat-goddess, Pasht. The speaker said, at the beginning of his lecture, that it was remarkable that while one of the latest writers on the East had referred to the failure of the prophecies of Ezekiel regarding the cities of Egypt, he had himself found in the same prophecies the light by which he was guided in his search. Bubastis was found to have been a city of much more historical importance than had generally been supposed, the recovered monuments bearing dates all the way down from the fourth (or Pyramid-builders') to the thirtieth, or last Egyptian, dynasty. The most conspicuous relics were of the fourth, sixth, twelfth, shepherds', nineteenth, and twenty-second dynasties. Some very interesting relics of the shepherd-kings, hitherto rare except at Tanis, were found; and from the beauty of their statues, and other evidences, the author concludes that they must have been a highly cultivated people, and have come probably from Mesopotamia. Dr. Virchow considered that their monuments represented Turanians, and Prof. Flower that they represented people of a Turanian or Mongolian type. But that did not mean that the population itself was Turanian. Their worship and language were of a Shemitic type, but the statues of their kings showed that they were not Shemites. M. Naville remarked: "It was then what it still is now; and I believe that the conquest of Egypt by the Hyksos is not unlike what would happen at the present day if the population of Mesopotamia overran the valley of the Nile: you would have masses, in great majority of Shemitic race, speaking a Shemitic language, and having a Shemitic religion, but under the command of Turks, who are not Shemites, but Turanians." M. Naville regards the successive discoveries that have been made in the Delta as making the Bible-story more comprehensible in some points, and as showing that the distances were much shorter than was generally thought. "I consider it important, for instance, to have established that Bubastis was a very large city, and a favorite resort of the king and his family. It is quite possible that, at the time when the events preceding the Exodus took place, the king was at Bubastis, and not at Tanis, as has been generally believed."

Composition of London Fogs.—Studies of London fogs by various observers show that during the winter the air of the metropolis has an unusually large amount of carbonic acid in it. Thus, Dr. W. J. Russell found on one day, a few years ago, that it contained more than three and a half times the average amount. This is derived, to a large extent, from respiration, and more from coal-burning; and "it is almost indisputable that the latter produces the well-known black fogs and yellow fogs." The relative thickness and density of the air of different parts of London have been investigated by Mr. W. H. Raffles, who took a station on Primrose Hill and observed the visibility, on different days, of prominent objects at known distances in different directions. These observations showed plainly that the amount of fog was largely governed by the density of the population and the frequency of factories. A similar conclusion is drawn from the number of hours in the daytime on which artificial light was used. Homerton had twice as many hours of darkness as any other district represented in the tables, and it has a very large number of factories in its neighborhood. Of other towns in which the inquiry was pursued, Leeds suffered most from darkness, probably for the same reason; while Manchester is said to have been unusually free of late years from dark fogs, probably because many mills have moved out. The ordinary white fog has also been reduced by the draining of morass lands near the city. A conception of the cost of London fogs may be gained from the fact that during nine days of fog in November, 1887, the public paid a single one of the several companies four hundred and ninety pounds, or twenty-four hundred and fifty dollars, an hour for artificial light.

Geological History of Yellowstone Park.—The geological history of Yellowstone National Park has been traced by Mr. Arnold Hague in an address before the American Institute of Mining Engineers. Throughout Tertiary time the history was characterized by great volcanic activity. Within very recent times there is no evidence of any considerable outburst; indeed, the region may be considered long since extinct. The volcanic rocks present a wide range in chemical and mineral composition and physical structure, but may all be classed in the groups, following one another in the order named—andesites, rhyolites, and basalts. Since the close of the Ice period no geological events of any moment have brought about any changes in the physical history of the region other than those produced by the direct action of steam and thermal waters. Indications of fresh lava-flows within historical times are wholly wanting. All our observations point in one direction, and lead to the theory that the cause of the high temperature of the waters of the geysers and hot springs must be found in the rocks below, and that the origin of the heat is in some way associated with the source of volcanic agency. But it does not follow that the waters themselves are derived from any deep-seated source; on the contrary, investigation tends to show that the waters brought up by the springs are mainly surface-waters which have percolated downward a sufficient distance to be heated by large volumes of steam ascending through fissures and vents from much greater depths. The existence of such currents of steam and hot water is attested by the decompositions they have effected upon the rocks, which "have proceeded on a most gigantic scale"; and they have left an indelible impression upon the surface of the country. The study of the age of the present geysers by observation of the rate of deposit of sinter indicates a great antiquity for them—over twenty-five thousand years for "Old Faithful." Our accurate knowledge of them only began in 1871. The number of geysers, hot springs, mud-pots, and paint-pots scattered over the park exceeds thirty-five hundred, and the addition of the fumaroles and solfataras would make the whole number of actual vents double that.

Mound-Builders and Indians.—"Some Popular Errors in regard to Mound-Builders and Indians" are reviewed by Mr. Gerard Fowke, in the "Ohio Archæological and Historical Quarterly." The high civilization ascribed to the mound-builders is denied, because they have left no evidence that they could use stone-dressing tools, could carry earth only in baskets or skins, and have left no indications of having possessed a written language or domestic animals, etc. Against the assumption that they possessed a great population, it is shown that while the construction of all their works in Ohio did not require an amount of labor equal to that used in the excavation of certain modern works, there is nothing in the way of their having had an indefinite time in which to perform it. While "there is sufficient accuracy in some cases to make one wonder that the builders could have done as well as they did, no evidence appears of any 'calculaation' beyond the mere sighting and measuring possible to any one." The supposed evidences of the great antiquity of the mounds and of the extensive commerce of the builders are assumed to be insufficient or fallacious; minor errors, concerning the distance from which the earth used in building the mounds had to be brought, concerning the size of the builders, the soundness and other peculiarities of their teeth, and the supposed artistic excellence of their work, are corrected; and the questions whether there is anything in their work that the Indians could not have executed, and whether the Indians had knowledge of them, are taken up. Traditions exist among the Indians of Michigan and Wisconsin of tribes who built mounds, and of definite occasions when mounds were built. A certain tribe were called by the Sioux Ground-House Indians, because they lived in houses covered with earth. The chronicles of De Soto's expedition describe the houses of the Cherokees as being built upon mounds, and the French give a similar description of the house of the king of the Natchez. Certain earthworks in western New York, Ohio, and Pennsylvania are conceded to have been built by the Iroquois and adjacent tribes. The Indians of the Ohio Valley may have been ignorant of the subject, because they were a comparatively recent arrival. It is objected that the Indians could not have built the mounds, because the builders must have been a settled and agricultural people, while the Indians live by hunting and fishing. But it is a historical fact that, before they were disturbed by the whites, the Indians also were agriculturists, raised good crops, and stored their grain, so that they were able to supply the expeditions that came among them. We can not judge of what they were from what they are, after having been ruined by their contests with the whites and their vices. The race that produced a Logan, a Corn Planter, a Red Jacket, a Tecumseh, and other men of like genius, might also have developed men competent to construct all the works that now puzzle us. Some of Mr. Fowke's assertions are traversed and shown to be erroneous in the "American Antiquarian," which, while it admits that the Indians built mounds, holds that there were other and more extensive mound-builders before them.

Experiments in Germination.—A series of testings of the influences of certain conditions on the sprouting of seeds, described in a bulletin of the experiment station at Cornell University, indicates that variations of temperature are an important factor in the matter, and that a constant temperature gives quicker results than an ordinarily variable one of which that is the mean. The mean employed in most of the experiments was 74°; but there is probably a tolerably well-defined best temperature for each species of plant, the limit of which is not closely determined for most garden seeds. Soaking the seeds does not appear to influence the total amount of sprouting; nor does it seem to hasten the sprouting, if the planting-time is reckoned from the moment of putting the seeds to soak; it only shortens the time the seeds have afterward to remain in the soil. The character of the soil may influence the results. Light, when it has any influence—and it has great influence with some species—has a retarding effect. The weight of the seed is often a tolerably accurate measure of its viability. As a rule, heavy seeds germinate better than light ones of the same sample. When variability was perceived with reference to color, the stronger sproutings usually occurred in the darker-colored seeds. The latitude in which seeds are grown may determine their behavior in germination—northern-grown seeds seeming to germinate more quickly than southern-grown. More than one test is needed to be decisive respecting any sample of seeds. There appear, from the testings reported, to be no pernicious adulteration of garden seeds in this country, and no hurtful impurities.

Tapioca.—The *manihot*, or tapioca plant, was originally a native of tropical South America, but is now largely cultivated throughout all tropical countries. It is a small, shrubby plant, growing from four to eight feet high; and becomes suitable for use in from sixteen to eighteen months after the young plants are established. Besides the well-known wholesome food, the root abounds in a peculiar poisonous juice, which is said to be analogous to hydrocyanic acid; but this substance being volatile and easily destroyed by fermentation, no difficulty is met in procuring the food-product free from it. The pulp obtained from the roots is washed in cold water, after which, upon resting, the starch subsides. The water is then drawn off and the starch is heated, when pearl tapioca is obtained. In preparing the cassava meal, the roots having been prepared, are baked on an iron plate. Thus prepared, the meal swells considerably in water or broth, and is called *cerraque*. If, instead of drying the grated pulp, it is spread upon a hot iron plate, the starch and mucilage, by mixing together, consolidate the pulp and form a biscuit, called cassava bread, which is a very important and nutritious food. The resultant of the mastication of these cakes, upon fermentation, produces an agreeable but intoxicating drink.

The Island of Paros and its Marbles.—The Island of Paros, according to Mr. R. Swan's description in the British Association, is eleven miles long and eight miles broad at its widest part, with a mountainous interior rising to a height of twenty-five hundred and thirty feet, and a broad belt of nearly level land round the coast. The southern part of the island consists chiefly of crystalline limestone, of undefined age but probably Cretaceous. The finest statuary marble, or lychnitis, varies from five to fifteen feet in thickness at the quarries of St. Minas, and occurs in a bed of coarse-grained white marble with bluish-black veins. The coarse marble becomes dark in color near the lychnitis, both above and below it, and thus the layer of statuary marble is distinctly marked off. The dark color is due to traces of binoxide of manganese and magnetic oxide of iron. The rocks are much disturbed and folded, and often dip at high angles. The ancients avoided the marble lying near the axis of elevation, which was of inferior quality to the other parts. A Greek company, formed a few years ago to work the quarries, attacked the rock here, where it could be got at least expense, and so discredited the marble in the market that it went down, after one hundred and sixty thousand pounds had been spent in getting the quarry ready. There is a good deal of excellent colored marble on the island, but, not having been used by the ancient Greeks, is not much known.

A Classification of Incendiaries.—Dr. J. A. Fowler, of Philadelphia, has made a classification of more than twenty different kinds of incendiaries, or motives to incendiarism. They are—1, the incendiary policy-holder; 2, the incendiary for gain or advantage other than insurance; 3, the revengeful incendiary; 4, the discharged hand; 5, the malicious servant; 6, the rioter; 7, the tramp; 8, the thief (for concealment of theft); 9, the thief (for opportunity for theft); 10, the murderer (for concealment of crime); 11, the incendiary for murder; 12, the mischievous small boy (or girl); 13, the contriver for incendiary reward; 14, the fire-bug, or fire conspirator (terrorizing by fire); 15, incendiarism from momentary rage; 16, the drunken incendiary; 17, incendiary firemen; 18, the don't-care bonfire-kindler; 19, the don't-care pyrotechnic exploder; 20, the don't-care manufacturer of unsafe kerosene, etc.; 21, the "pyromaniac." The last four can not be considered legal incendiaries, "but they bring the trespass so near the crime that they can be admitted into the insurance catalogue of incendiaries as practically such."

The Condition of Deep-Sea Life.—It is suggested by Mr. A. R. Hunt, in "Nature," that the depth of the horizon above which deep-sea fish do not rise, is controlled rather by the matter of wave-motion than of the penetration of light. It is doubtful if sunlight ever penetrates to the depth of a hundred fathoms, which Günther has indicated as marking the beginning of deep-sea life; but that depth has been indicated by Mr. Hunt as the extreme depth to which wave-action reaches. This view is fortified by the fact that, though the deep-sea forms do not usually ascend above the hundred-fathom line, the shallow-water forms go far below it; and there is no reason why they should not do so; for, although a form unfitted to withstand wave-currents can not face them, there is nothing to prevent a flat fish, fully-equipped as to this condition, from passing at will from the disturbed to the tranquil horizon, and returning.

The History of the Doctrine of Assassination.—The history of the doctrine of political assassination or tyrannicide has been elucidated by a writer in the "Edinburgh Review." It prevailed among the ancients, as is illustrated in the stories of Brutus and of Harmodius and Aristogiton. Its great apologists have been the Jesuits, but it is much older in its Christian form than the Jesuit order. At the beginning of the fifteenth century, not to go further back, a Franciscan friar, Jean Petit, who was Professor of Theology at Paris, undertook to justify the murder of the Duke of Orleans, on the plea that "it is lawful, by natural and divine law, for every subject to kill or cause to be killed a traitorous and disloyal tyrant." His teaching was denounced by Gerson and condemned by the Council of Constance. The decree of the council was, however, rejected by one author because it was not sanctioned by the Pope; while others sought to evade its force by making a distinction between a tyrant *in titulo*, or a usurper, and a tyrant *in regimine*, who is a lawful sovereign but has abused his trust. The decree could not, these writers alleged, apply to the tyrant *in titulo*, because a usurper has no subjects. Mariana, in his famous work "De Rege et Regis Institutione," published in 1599, defined as tyrants all sovereigns, legitimate or not, who forfeit their rights by governing for their own selfish interests, not for the good of their people; and held that such unjust rulers became the enemies of the human race, and might lawfully be slain by their subjects. He argued that the sovereign power is always dependent on popular consent, and that a tyrant is worse than a ferocious wild beast. When there existed a public assembly in the country, it should meet and pronounce sentence first, but, where no such resource was available, any person who had the courage might lawfully make himself the interpreter of the popular will. But the use of poison was forbidden by the common sense of mankind. The doctrine is, however, a most mischievous one, which is easily made to work both ways.

Evolution and Disease.—Dr. R. G. Eccles, in a paper on "Heredity and Disease," advises the application of the principles of evolution to pathological studies. "A vague, uncritical sort of belief in the transmission of disease tendencies," he says, "has obtained among general practitioners for a long time. Few have dared to allow themselves to speculate upon the possibility of this chain of tendencies stretching back into the world of animated nature below us. No one has a due conception of the vast magnitude of the possibilities involved in so daring a speculation. Is there any reason for believing that a large number of weaknesses and disease tendencies of the human family are part of this great system that makes us appear as if we had descended from quadrupeds? What harm can it do for us to work on this assumption for a while, and see whether or not it will prove as fruitful to the pathologist as it has been to the botanist, zoölogist, and physiologist?" In a similar vein Dr. Wesley Mills regards the various forms of disease as so many cases, by the deterioration of his higher faculties, of reversion toward the lower forms from which man is derived. Thus, the dying human subject sinks functionally lower and lower in the scale of animal life. In sleep it will be seen, if we consider the nervous system, that the parts peculiar to man, or most developed in man, are the ones that for the time being are as good as annihilated. Similar tendencies toward a sinking to equality with lower forms may be observed in hypnotism, somnambulism, and allied phenomena. It is seen, on a lower level, in hibernation, when certain normally very active animals return to a condition like that present in cold-blooded animals. In paralysis, the graver the affliction the lower in the scale must we seek to find an animal comparable to man in that condition. Views in harmony with those of Prof. Mills were published by Dr. Milner Fothergill.

The Office of Iron in the Blood.—Iron exists in the blood in the red corpuscles, and gives them color and the power of absorbing gases. The fact that peroxide of iron is one of the readiest absorbents of gases, and parts with them as readily on exposure in thin layers to the air, so that it can be used over and over again for that work, gives a clew to its special function in the red corpuscles of the blood. It enables them readily to absorb oxygen as they pass along the minute blood-vessels of the lungs, and to carry it to all parts of the body, where they part with it as it is demanded. It is supposed, also, to take up carbonic acid in exchange for the oxygen it yields up, and to convey to the lungs that portion of this substance which is expired. If this be its double function, it is one the importance of which can hardly be exaggerated; for it is, in effect, to be the vehicle to all parts of the organism of that which makes them vital, while it also removes the waste of their life, which would otherwise clog their activity. The chemical changes in the life of plants are effected by means of the iron which is contained in the chlorophyl by processes that differ in particulars, but are dependent on the same absorption principle of the peroxide. Thus "it is an interesting coincidence that iron should be the active agent in both animal and vegetable life for the assimilation of the air substances required for their existence; and that at the same time it should be intimately connected with the production of the distinctive color of the blood and of the foliage of plants."

Iron Railway-Ties.—Iron sleepers or cross-ties have been in use for many years on the railroads of India, and have proved as free from liability to accident as wooden ties. The East India Railroad has more than one thousand miles laid with them, and is adding to the length every year. It runs the fastest and heaviest trains on the peninsula, and has enjoyed an almost proverbial immunity from accidents. The "bowl sleeper" appears to be the standard type, although it was once condemned. It lies more steadily and is less liable to horizontal displacement than any wooden sleeper. It, however, makes the track too rigid, and is not suitable for high speed, and is likely to be discontinued again. A tie called the "D and O sleeper" gives a more elastic track, and is more conveniently packed than the hollow sleepers.

NOTES.

The Board of Directors of the Zoölogical Society of Philadelphia asserts in its last report that the collection has at no previous time been so well able to fill its part among the educational institutions of the city as at present. It contains a sufficient variety of specimens to give a comprehensive idea of the four classes of vertebrates. Some of the larger groups are exceptionally well represented. The series of monkeys is large, and contains a number of species rarely seen in captivity, as well as six specimens of lemurs. The collection of parrots is also worthy of special attention. Arrangements have been made for securing an extensive collection of North American forms of reptiles and amphibians.

A review of "The Sociological Position of Protection and Free Trade" leads Mr. Lester F. Ward to the conclusion that "free trade, *laissez-faire*, and individualism in general, represent the untamed forces of nature, such as would exist in the physical world had there never been any inventions, contrivances, machinery, or arts"; while "protection belongs to the great class of ingenious instrumentalities which the civilized brain of man has learned to devise and employ for the regulation, control, and utilization of natural agencies."

THE studies of Sir J. William Dawson on the Eozoic and Palæozoic rocks of the Atlantic coast of Canada have led him to a conclusion that, in the rocks from the Lawrentian to the Trias, a continuous parallelism exists on the two sides of the Atlantic, in mineral character and order of succession of aqueous deposits; in the occurrence of great earth-movements of elevation, depression, and plication, at corresponding times; in the ejection of like kinds of igneous rocks in connection with like members of the aqueous series; in the order of introduction and extinction of animals and plants; and in the specific identity of animals and plants in corresponding formations.

PROF. WILLIAMSON has reported, in the British Association, concerning some specimens of the fruiting of the *Calamites* of the coal-measures, which he regarded as demonstrating his opinion that these plants were equisetiform cryptogams.

THE experiment of amalgamating the Indians with the surrounding population in Canada and inducing them to adopt a settled life has been most successful in Ontario, and in all cases the tribes show an increase in numbers. There are 124,589 Indians in the Dominion, of whom 37,944 are in British Columbia; 26,368 in Manitoba and the Northwestern Territory, 17,700 in Ontario, 12,465 in Quebec, 8,000 in Athabasca, 7,000 in the Mackenzie district, 4,016 in Eastern Rupert's Land, 4,000 on the arctic coasts, 2,145 in Nova Scotia, 20,338 in the Peace River district, 1,594 in New Brunswick, 1,000 in the interior of Labrador, and 319 in Prince Edward Island. The Indian schools are attended by 6,127 youth and girls, one half of them being in Manitoba and the Northwestern Territory.

EXPERIMENTS by Mr. J. B. Francis, of the American Society of Civil Engineers, show that under a pressure of seventy-seven pounds per square inch, more than seventeen gallons of water per square foot of surface will pass through sixteen inches of cement in twenty-four hours. Thick brick-work laid in cement permitted a copious percolation of water under pressure.

"LA NATURE" has a commendatory notice of the display of American precious stones that has been arranged by Mr. George F. Kunz, of this city. It includes splendid specimens of native crystallized gold from California; diamonds; "incomparable" rubies, including one quite exceptional in color and limpidity, from Franklin, N. C.; sapphires of rare quality, emeralds, tourmalines, perfectly clear rock crystals, periodotites; amethysts of a deep, transparent violet; obsidian, gadolinite, and turquoises; also specimens of Indian jewelry-work, in which turquoises are used; "superb" specimens of pyrites, azurite, malachite, and amber are also mentioned.

DR. ALFREDO DA LUY, of Rio Janeiro, believes that the climate of Brazil is degenerating to Europeans, especially to persons from the north. He has noticed that Brazilians in general are more pallid, and are less vigorous and energetic, than persons coming from temperate and cold climates. The degeneration of the Portuguese race may also be noted in Rio de Janeiro. An anæmic condition, caused by malarious influences, is common among them, and, while it does not kill by itself, weakens the hold on life and greatly increases the infant mortalty. The children of Portuguese and Italians do not seem to fare so badly as the children of parents coming from more northern countries.

ACCORDING to Dr. Macgowan, it is believed in India, China, and Indo-China that a cobra that escapes an attack from a man will eventually revenge itself upon its assailant, whatever he may do or wherever he may go. The Chinese believe, too, that the killer of a cobra will be haunted afterward by its spirit, hence the snakes are shunned rather than attacked. Among the stories by which this superstition is enforced, is one of a snake-spirit which, entering into possession of the slayer of the reptile, used its voice to curse him until he was relieved by death. Stories are also given of the gratitude of snakes. The recently established native newspapers of China are full of accounts of popular superstitions, prodigies, tales, monstrosities, etc., illustrating the folk-lore of the country.

"THE LANCET" observes that it has been frequently remarked that genius and insanity are sometimes combined in the same person or in closely connected members of the same family; but it is not easy to trace the connection between those mental conditions and the sinful or criminal acts that are apt to be committed by persons so organized. The medical profession recognizes forms of affection or moral insanity in which the capacity to govern the emotions is in abeyance. A marked feature of this phase of mental disease is the absence of delusions; and from that fact conflict often arises between the medical and legal aspects when the question of criminality has to be taken into consideration.

PROF. STEENSTRUP has given an account, to the Scientific Society of Copenhagen, of the results of his examination of a great mammoth deposit at Predmost, in Moravia. Dr. Wankel and Prof. Maschka believe that the animals were killed by man and brought to the district to be eaten. Prof. Steenstrup believes that they came to the place of themselves, and died from some cause with which man had nothing to do. But, in maintaining his position, he has to account for some of the bones being split, for their bearing marks of fire, and for decorative lines having been scratched upon them.

Discussing the relation of occupations and trades to public health, Dr. John T. Alridge remarks that erroneous conclusions may be drawn by overlooking factors which, though potent, are not prominent to view. Thus, as a general rule, light occupations, in good social credit, will attract a large ratio of weak lives, pronounced incapable of active labor. Such an occupation is that of clerk; and we must not lay too much stress on its unhealthfulness as being a sedentary calling, when, in truth, it is largely filled with persons already of sickly habit. Dr. Alridge believes that inhalation of dust is a most effective cause of disease, and that those occupations in which much dust is stirred are intrinsically the most unhealthy.

In providing for the water-supply and the disposal of the sewage of the city of Toronto, engineers have to deal with the problem which is presented by the necessity of drawing the water from and returning the sewage to the same body—Lake Ontario. The water intake is now through a crib fixed at about two thousand feet from the outer shore of the island that lies in front of the harbor. Messrs. Rudolp Hering and Samuel W. Gray, who were invited to study the subject and report upon it, have reached the conclusion that "for many years to come no objection can arise and no pollution will be observed, if the sewage outfall is placed as proposed, six and one half miles from the present water intake."

The British Association Committee on the circulation of the underground waters of the kingdom, etc., reports that since it was appointed, fourteen years ago, the recognition of those stores as affording efficient supplies of water free from organic impurity at relatively little cost has made great progress. The publication of the results already obtained has been greatly appreciated by engineers and contractors, and has helped and supported recommendations of water-supplies from underground sources. As time goes on, large numbers of borings are annually made; and numerous provincial societies are giving attention to the subject and publishing results.

Mr. J. A. Loudon, of Newcastle, showed in the British Association that peat fiber can furnish a suitable material for the manufacture of brown paper, wrappers, and mill-boards. It is not, however, available for white paper.

A method of making bottles by machinery was described by Mr. H. M. Ashley in the British Association. The resultant bottle is homogeneous, with ring, neck, body, and bottom, all as one. Specimens had been subjected to an internal pressure of three hundred poundst to the square inch without any being broken. The use of the method is expected to do away with the most unhealthy part of the ordinary process of blowing bottles.

OBITUARY NOTES.

Mr. C. Spence Bate, a British authority on crustaceans, has recently died at Plymouth. He was the author of a report on a class of crustaceans collected by the Challenger Expedition; of a catalogue of certain crustaceans in the British Museum; of a "History of British Sessile-eyed Crustaceans"; and of a work on the "Pathology of Dental Caries."

Prof. George H. Cook, of Rutgers College, and State Geologist of New Jersey, died at New Brunswick, in that State, September 22d, in the seventy-third year of his age. He was born at Hanover, N. J.; became a civil engineer in 1836; laid out the line of the Catskill and Canajoharie Railroad; was graduated from Troy Polytechnic Institute in 1839; was made senior professor in that institution in 1840; became Professor of Mathematics and Natural Philosophy in Albany Academy in 1842; Principal of the Academy in 1858; Professor of Chemistry and Natural Philosophy in Rutgers College in 1852; Assistant Geologist of New Jersey in the next year, and State Geologist in 1864, when he was also made Vice-President of the State Scientific College. He was actively connected with the State Board of Agriculture; became Director of the State Weather Service; visited Europe three times on scientific errands; and was associated with many public enterprises.

Prof. Leo Lesquereux, the eminent botanist and paleontologist, died at Columbus, Ohio, October 25th, in the eighty-fourth year of his age. He was a native of Switzerland, was a friend of Guyot and Agassiz, and came to the United States in 1848. He was the author of nearly fifty scientific works; and in his special field of study he ranked with Oswald Heer. A sketch of his life and works, accompanied by a portrait and a list of his writings, was published in "The Popular Science Monthly" for April, 1887.

Dr. James Prescott Joule, F. R. S., the discoverer of the mechanical equivalent of heat, died at Sale, near Manchester, England, October 11th. He was the son of a brewer in Salford, and was born in 1818. His first contribution to scientific literature was made when he was about twenty years old, in a paper describing an electro-magnetic engine. His great discovery was made after patient, independent investigation and experiment, with extremely simple apparatus constructed by himself. He constructed electro-magnets of greater carrying power than any previously known; devised electro-magnetic engines and new forms of galvanometers; measured the heat evolved by the passage of electricity through mechanical conductors; and determined the ratio between chemical and thermal energy. A sketch of his life and a portrait were given in "The Popular Science Monthly" for May, 1874.

ALEXANDER WILSON.

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THE FUTURE SITUS OF THE COTTON MANUFACTURE OF THE UNITED STATES.*

By EDWARD ATKINSON, LL. D., Ph. D.

I have been asked to treat two subjects: 1. Is the present number or the recent increase of cotton-spindles in the United States actually or relatively in excess of the requirements of the population?

2. Is the South likely to become a formidable competitor with New England in the cotton manufacture?

I submit the facts from which I have made my own deductions, and from which each one may draw his own conclusions according to his own judgment.

When dealing with the first branch of the subject, as all are well aware, we must qualify any conclusion based on the actual number of spindles by making allowance for higher speed and greater product per spindle in recent years; hence larger relative product. On the other hand, we must qualify the data of the spindles by the consideration that the average number of yarn spun at the present time is much finer than it was twenty years ago; hence a less proportionate product per spindle.

Again, we must qualify our deductions derived from the actual number of spindles, after having made allowances for high speed and fine numbers, which may perhaps be held to balance each other, by taking into consideration the very rapid increase in both national wealth and general welfare in recent years; hence a greater consumption of cotton fabrics per capita. This increase in purchasing power and this choice of better and more expensive fabrics are very noticeable in the Southern States, and especially so in respect to the colored population on Sundays and holidays. After balancing higher speed against the finer number, this last element of greater power to purchase would lead us to assume, or to expect to find, a steady but moderate increase in the ratio of spindles to population: when I give the facts, I think many will be somewhat surprised at the justification which the figures will give of this hypothesis.

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* A paper prepared for the New England Cotton Manufacturers' Association, and presented at their meeting, October 30, 1889.

In treating the conditions of the South I date my computations from the year 1870. This was the year in which the worst effects of the war had been in part overcome. In 1870 our Southern friends made a fair beginning, on which they continued in rather slow and even measure in their progress until about 1880, when at last the new industries of the new South began to make progress with leaps and bounds; the greatest impetus being imputed to the Atlanta Cotton Exhibition by the Southerners themselves. It seems as if the display in this exhibition had shown to themselves, even for the first time, the wealth of minerals, of timber, and of other resources which proved to them that cotton was very far from being king even of its own land.

There is another very important factor which enters into this consideration to which no attention has been given in any treatise upon Southern manufactures that I have yet seen, namely, the great number of people in the Southern States who were clad in homespun or in hand-woven fabrics, both before the war and throughout the period of reconstruction down to 1870.

The moment attention is called to this element in the question, all will doubtless admit that a change from homespun to factory-made goods, whatever its measure may have been, was the equivalent of so much added population and so much increased demand for the products of the cotton-factories. Conversely, in any computation of the ratio of spindles to population at different dates, a deduction must be made in 1860 and 1870 for those who were at these respective dates clothed in hand-made fabrics. Perhaps it may be said, and perhaps it may rightly be said, that if an allowance must be made according to each man's judgment for all these variable elements of the problem, what dependence can be put upon the final figures? Each one may answer his own question or doubt in his own way. I shall only give what appear to be the facts, and I will say, as I have so often said before, that all statistics, unless qualified by sound judgment, are mere rubbish, not worth the compilation. I think many may be somewhat surprised, however, by the apparent certainty of the rule presented.

I have corresponded with a large number of my old Southern friends in respect to the homespun consumption of former times. I omit Texas from among the Southern States, for the reason that it has always been more like a Western State; that it never had any considerable number of cotton-spindles within its borders, and that its people were never clad in hand-made fabrics to any considerable extent. I include under the name of Southern States Alabama, Arkansas, Florida, Georgia, Kentucky, Louisiana, Mississippi, North Carolina, South Carolina, Tennessee, and Virginia, including West Virginia.

In 1860 the population of these specific States numbered 9,650,000; in 1870, 10,432,000; in 1880, 13,665,000; and at the present time their population, without question, exceeds 17,000,000.

From the best information which I can obtain, and in the best judgment of old planters, dealers, and manufacturers, nearly the whole population of the middle or mountain section of these States, two to three millions in number—a very large portion of the colored people on the plantations, probably two or three millions more out of four millions—and a very considerable part of the population of country districts aside from these two classes, were clad in homespun or hand-woven fabrics prior to 1860. The average of the estimates which I have received would put more than one half, or about five millions of the population in 1860, of these Southern States into this class.

In 1870 very moderate progress had been made in displacing hand-made fabrics with the products of Southern factories, but the more prosperous people were consuming more Northern goods of finer quality. The average judgment of my correspondents indicates that in 1870 at least forty per cent of the population were clad in hand-spun or hand-woven fabrics. I estimate it at one third, numbering three and a half millions, in my succeeding computations.

At the Atlanta Exposition Mr. F. E. Clark, of the Pemberton Mill, and myself, computed the product of two hand carders, two spinsters, and one hand-loom weaver, who were working on thirty-two-inch Osnaburgs, about thirty-six picks to the inch, at eight yards a day of ten hours. Five operatives in the Pemberton could have turned out eight hundred yards of the same fabric in the same number of hours.

In my computation of the ratio of spindles to population I deduct 4,800,000 in 1860; 3,500,000 in 1870; in 1880 I make no deduction for hand-work, for the reason that the art was then nearly a lost art. A few home spinners and weavers may still be found only in the heart of the mountains of Kentucky and North Carolina. On this basis the cotton-spindles of 1860, numbering 5,235,727, bore the ratio of one spindle to each of 5·05 of the remaining population; 1870, spindles 7,132,415, one spindle to 4·92 of the remaining population; 1880, spindles 10,653,435, one spindle to 4·71 of the total population; 1889, September 1st, spindles estimated by the "Financial Chronicle," 14,175,000, one spindle to 4·52 of the probable population, now computed at sixty-four millions.

Our exports have varied, but not enough to affect the average materially. They are a little more in value now than they were in 1860, but not so much in ratio to product. These facts appear to sustain the theory that the increased purchasing power of the population will sustain a small relative increase in spindles per capita.

Now, any one can form his own judgment as to whether or not the spindles are in excess of our present population. In view of the greater variety of uses to which cotton fabrics are now put, in view of the greater purchasing power, in view of the very low prices of cotton fabrics, and in view of the extravagant habits of the people, my own judgment is that the spindles are *not* in excess of the population; on an even balance we may of course be subject to an overstock of special goods, such as affects some classes, especially export goods at the present time. In the long run I think that we are more likely to require a ratio of one spindle to four than to go back to the ratio of one to five persons. We now gain in population nearly or quite two millions in a year. The average of the next ten years may be two million two hundred thousand each year. On the basis of two millions which is substantially the present rate, if we require one spindle to each five of the population, we must add four hundred thousand new spindles every year to our present number; at one to four and a half, four hundred and forty-four thousand; at one to four, five hundred thousand, besides providing for the increasing wants of the existing population. It would then appear that we may require five million new spindles in addition to our present number during the next ten years, to meet the increased home consumption of cotton fabrics, no consideration being given to any increase in exports. Please do not exaggerate the importance of this forecast, and don't be in a hurry to double your investments.

Five hundred thousand spindles a year will only cost sixty to eighty million dollars, varying according to the number of yarn. Now, all life and progress consist in a conversion of force. We convert the food, the fuel, and the clothing which we consume—

1. To sustaining life.
2. To an increase of capital.

We may, therefore, take any single element of our food as a standard by which to measure the relative increase of our capital into which it may be in part converted. My favorite standard is the *egg* standard! Agassiz went to the egg to find the unit of life, I go to the egg to find the relative standard of production and of savings. Don't crow very much over your own little egg; it may be only a Bantam. If each adult of the present population consumes hens' eggs at the rate of consumption in your own factory boarding-houses, the hen-yards of the country now supply about one hundred and twenty-five million dollars' worth of eggs a year, and by exchange and conversion into capital this sum would suffice to build all these cotton-factories and to supply the working capital as well, year by year.

Again, in *two* years only out of this ten ensuing, as much capital will be expended in the construction of new railroads in this country as the whole five million spindles which we may need in *ten* years will cost.

Or, again, if we assign only five hundred dollars to the construction of a dwelling-place to each five persons comprised in this increase of population, the capital which will be needed to house them will come to two hundred and twenty-five million dollars a year, or $2,250,000,000 in all.

So the world wags on, always within one year of starvation, within two years or so of being naked, and within a few years of being houseless and homeless, except for the work which we must do to supply the products which we must exchange with each other—eggs for cottons and cottons for eggs, etc.

This may be a pleasant prospect for our machine-shops. They will also have a good deal of work to do in substituting new spindles for old, and perhaps new looms for old, if the double-faced, fast-running, vertical loom does the work which is expected of it. How soon will your present noisy, cumbrous, and unscientific loom be invented out of existence? When will it be displaced by a smooth-running, circular loom? How about your carding-engines, your drawing and your combing machines? Are we to go on importing them? Yes, until the taxes are taken from the metals and from the other crude materials which are needed to make them. Iron has cost you for ten years previous to the present year (1889) ten dollars per ton on the common grades, and steel fifteen to twenty-five dollars per ton more than the same materials cost the machinists of Great Britain; thus enhancing the cost of your capital, and placing you at a disadvantage in competition with the manufacturers of Great Britain, Germany, Belgium, Switzerland, and almost all the other manufacturing countries in which such materials are free from taxes. The lower the prices of metal the greater this disparity.

I think we shall not even secure our home market, much less extend our foreign sale, so long as the prices of crude materials are kept by taxation far above those of our competitors. If, however, there should be a change in the policy of the country, to which all events appear to be tending, and to which the advocates of both sides of the tariff question appear to be moving, and it should be decided that the crude materials, commonly called "raw materials," and the partly manufactured products which are necessary in the processes of domestic industry, should be imported free of tax, I think there could then be very little doubt that we should not only control our home market, but also secure a much larger share in supplying other nations with cotton fabrics than we now enjoy. The number of our spindles might then be almost indefinitely extended; and when the prices of iron, steel, and copper are the same in this country as they are in Great Britain, making allowance for the cost of transportation, as they would be if free of duty here, I doubt if any carding-engine, combing-machine, or spinning-machinery, or any other important part of the plant, except some specialties, could be imported from any other country.

The annual consumption of iron and steel in this country is now thirty-five to forty per cent of the commercial or known product of the world. It is equal to the entire commercial product of the world in the years 1865 and 1866. It is in excess of the largest product ever made by Great Britain. Now, it is upon supremacy in iron more than anything else that the control of commerce rests, and I think we shall soon hold it without lowering our prices materially, but in consequence of rising prices abroad. The deposits of fine iron ore suitable for making Bessemer steel are rapidly diminishing in Great Britain in ratio to the demand upon them. The coking coals, which are necessary in the work, are becoming more costly year by year. As the mines become deeper they become hotter, and the veins in Durham, the chief source of supply, are only two feet wide, and they lie horizontally, so that the miners must work at a great depth in a very heated atmosphere, lying on their sides. As the necessary consequence, although the wages of labor are much less, the cost of coke is much higher than it is in this country.

Great Britain now imports twenty per cent of all her ores. The chief supply of fine ore has been in the neighborhood of Barcelona, Spain, but that supply is becoming exhausted. When that time comes, Great Britain must get her supply of fine ores from the south of Spain—inside the gates of Gibraltar—from Algiers, or from mines not yet worked to any great extent, three hundred miles from the extreme northern end of the Baltic Sea, in Sweden.

The supply of workmen capable of operating iron-furnaces and steel-works in Great Britain is also relatively small, so that with each advance in the price of iron, an advance in wages is demanded—not due to improvements in the processes, but due to the relative scarcity of laborers. On the other hand, the demand for iron upon the furnaces, both of Great Britain and of this country, which for many years varied with the activity or depression in the construction of railroads in this country, is now active. The very rapid extension of railways, not only upon this continent but upon other continents, has induced an enormous demand for iron and steel for other purposes. Therefore, during the last years, 1888 and 1889, although the construction of new railways diminished from the standard of 1887 by fifty to sixty per cent, yet the demand for iron and steel has gone on increasing, and is now larger than was ever known before.

Again, the new sources of supply in this country are rapidly furnishing iron at low prices, but at such profits that the production increases very rapidly so as to meet the increasing demand. In spite of this, there are indications of an insufficient supply of iron the world over, from which, of course, the present rising prices have ensued. Now, the production of iron is a matter of relatively small consequence, either in the value of the product or the number of men employed, as compared with the consumption. Gauged by my favorite standard, even the present large production of iron in the United States is only equal in value to the product of hens' eggs.

Now, suppose for an instant that under these conditions of increasing demand we were to remove the duties. New England would at once supply herself with ores and coal from the vast and easily worked deposits of Nova Scotia. The New England production of heavy machinery would be resumed, and we should no longer send to Milwaukee for our heavy stationary engines, but should again make them either at South Boston or in Providence. Even then it would be doubtful if the supply of iron could keep up with the increasing demand.

Then imagine, if you can, what would be the effect upon the price of iron in Great Britain, if we were to call upon her only for a million tons extra, or only for the increase which we shall require next year. That would be a demand for about twelve and a half per cent in addition to the present product of her ironworks, and even the present product can not be kept up without a great increase of cost. Witness the recent statements in the London "Economist" to that effect.

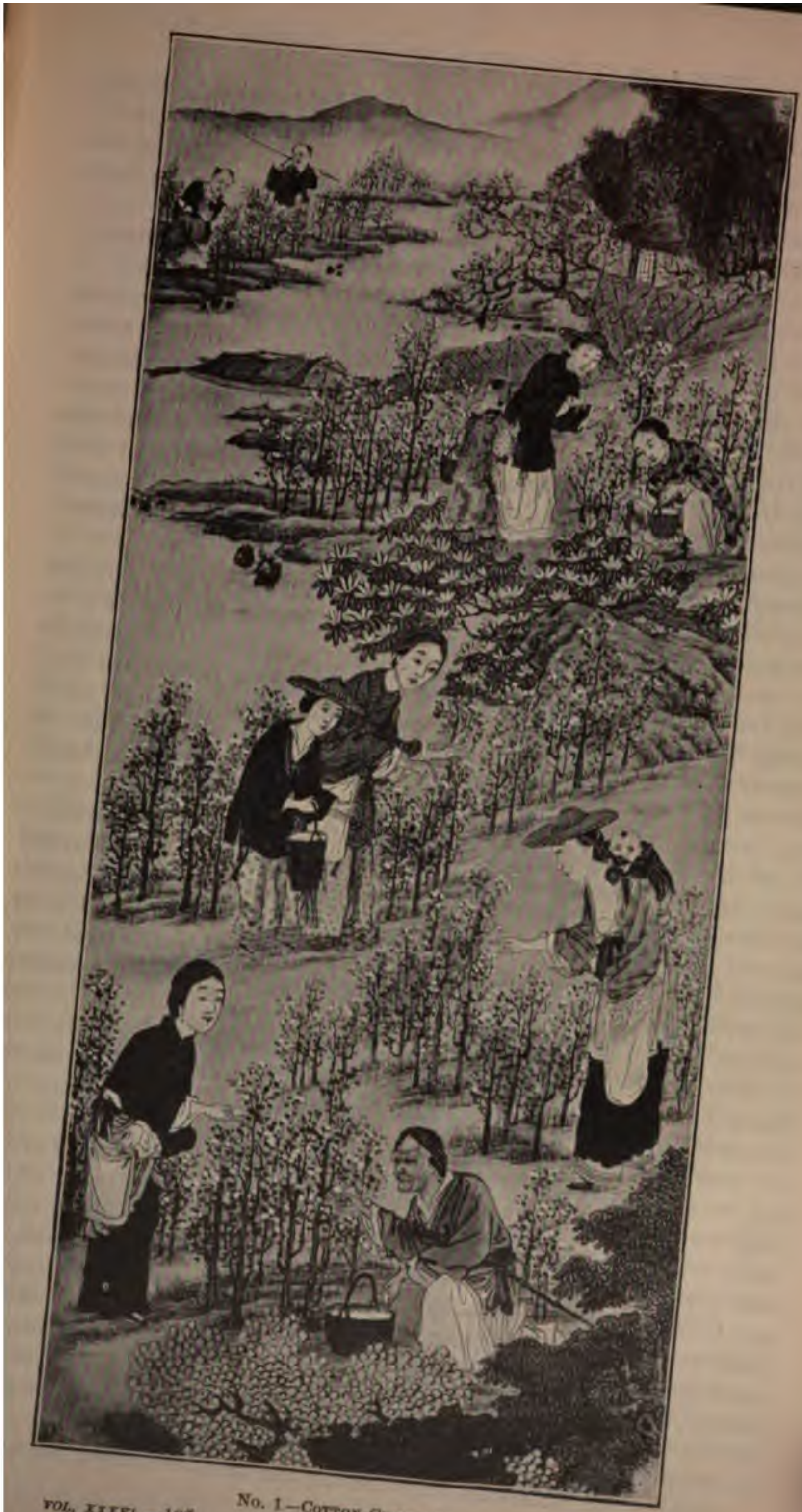
Finally, let it be assumed that, without any reduction in the present low price of iron in this country, the consumers of iron in Great Britain—the machinists, the builders of ships, of locomotives, the makers of rails, and the like—were called upon to pay as much for their iron and steel as our consumers of iron now pay, what would be the result? They have had an advantage ranging from five to ten dollars per ton of iron, and from fifteen to thirty dollars per ton of steel, for many years, over our machinists, engine-builders, and ship-builders. Imagine what the conditions would be, if you can, if our relations were reversed, and if crude iron and crude steel could be had at lower prices in this country than in Europe; yet that is what is more likely to occur than anything else, and that time would be greatly hastened by the instant removal of duties on ore and coal, and perhaps by the immediate removal of every duty on pig-iron, although prudence might require a period of five years or so to carry out the latter policy by successive reduction.

I think we have been protecting the machinists, engine-builders, and ship-owners of Great Britain, and retarding the progress of our own, by keeping up a disparity in the price of the materials which form the chief element of cost from fifty to a hundred per cent higher in this country than they have been there. How can we expect to keep the control of the home market on machinery when the duty on the materials is fifty to a hundred per cent higher than on the machine itself? I think it is time this question was taken out of politics and settled by sensible men in a sensible way; but that may be a visionary theory, which I may not live to see reduced to practice.

I speak of this subject because it has a most important bearing upon the question which has been put to me. We can readily overstock our own market, which is small compared with the demand of the world. Glance at the accompanying pictures which represent the present conditions of the cotton manufacture of the great empire of China. In No. 1 is seen the cotton growing; in No. 2, the clearing from the seed by snapping a bow-string with the hand, which gave the name of "bowed Georgia" to Southern cotton before Whitney invented the saw gin; No. 3 shows the press; No. 4 the spinning-wheel, No. 5 the warper, and No. 6 the hand loom, as they have been in use since prehistoric times. In one of these pictures there is a bit of evidence of manual dexterity which is hardly credible: one woman appears to be spinning three strands from three separate rovings on one wheel.

The latest and most authentic computation of the population of the globe is fourteen hundred millions. The manufacturing or machine-using nations of the world—that is to say, the nations which have to any considerable extent adopted the factory system of making textile fabrics—consist mainly of the inhabitants of this country, of Canada, of Great Britain, France, Germany, Belgium, Holland and Switzerland, numbering in all about two hundred millions.

The only nation, and, in fact, perhaps the only country, which makes cotton fabrics to any extent in excess of its own consumption is England. We import more cotton fabrics than we export, but they are chiefly of the finer kinds, or else they are laces, embroideries, and the like. I am not quite sure, but I think that even France and Germany import more cotton fabrics than they



No. 1—Cotton Culture.

export, if the fine yarns are included in their import, which can only be made for them in Lancashire. There are, as you are aware, a few cotton-factories in Russia and a few in India, but their product in ratio to the consumption of the continent of Asia is utterly insignificant.

The number of people who are at this time clothed in hand-spun and hand-woven fabrics is more than double the number of those who yet purchase the fabrics which are made in our factories or in those of any other nation. I made a computation a few years since, and I think the conditions have not greatly changed, to this effect: that all the cotton fabrics exported from Europe and from the United States to China would only suffice to clothe sixty to seventy millions out of a computed population of four hundred millions—even at the ratio of only two and a half pounds of cotton to the head. I consider that ratio incorrect, although it is commonly used.

A large part of China in which there is a very dense population, and to which most of our drills and sheetings are sent, is in the same latitude as the northern United States. It is not as cold, but yet it is a cold country, and the common people are clad wholly in cotton fabrics. Here are one of their coats and some of their other garments. You can judge for yourself whether or not they consume more than two and a half pounds per head. This coat alone weighs nearly four pounds.

At five pounds per head, which is a much more reasonable estimate, the factory-made fabrics of this country and of Europe would not suffice to clothe more than ten per cent of the population of China. There has been an ill-defined dread lest China should build cotton-factories and then should undertake to clothe us with the products of the cheap labor of the "heathen Chinee."

Now, entirely aside from the fact that low-priced labor is not cheap labor, and that high-priced labor is cheap because more effective in making goods at low cost, I venture to ask if any of my readers ever bought or spun any Chinese cotton? I think very few of the present generation have had any experience even with Surats or India cotton. I think those who know even what India cotton is will not dread any serious competition from that, and the very few—perhaps I am the only one who ever bought any Chinese cotton—will after that experience lay aside all fear of Chinese competition in the contest for supremacy in the cotton manufacture. It is the whitest, cleanest, and most honestly packed, but also the shortest, meanest, and most worthless cotton of which I ever attempted to draw the staple or to put through a factory.

The Appalachian chain, gathering the moisture from the Gulf

Stream and spreading it over the fertile cotton-fields of the United States, has fixed our supremacy in cotton production and probably in the cotton manufacture of the future, until Egypt is more fully redeemed from barbarism, or until the lands bordering upon the Paraguay and Parana Rivers in South America are more fully occupied by a dense and industrious population.

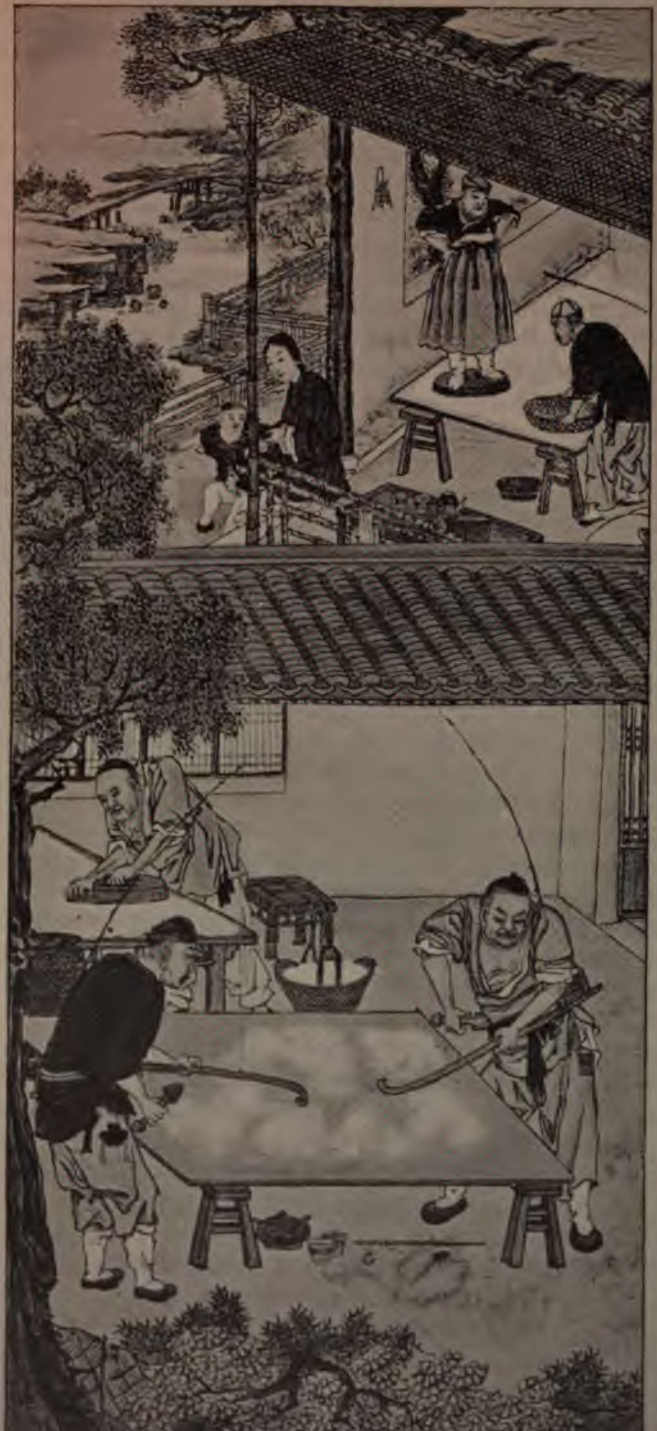
But perhaps the seat of the cotton manufacture of the future may not be wholly where the cotton grows. Cotton is a sun-plant. It thrives best and yields the largest product in the hot, dry years when the dryness does not become a drought. The very characteristics of climate which promote the production of the fiber are to some extent inconsistent both with spinning and weaving, which call for a cool, moist atmosphere. The variety of Dacca muslin so fine as to have been called the "woven wind" is spun and woven only in the early morning by weavers who sit upon the ground under the trees where the humidity of the air is greatest. I believe they even dig a hole in the ground, in which they sit, so as to bring the web in front of them close to the ground.

This brings us to the question of prime interest to all of us. Will that Southern cotton land also become the principal site of the cotton manufacture of the United States? Upon this question I will first submit the facts, and I will then give the conclusions which I have myself derived from them.

The number of spinning and weaving mills in the Southern States which I have named, both before the war and subsequently down to 1870, was not sufficient to be considered a factor of any considerable importance. In 1860 the number of Southern spindles was about five per cent of the total number of spindles of the country. They were in by far the greatest proportion devoted to spinning coarse yarns to be woven upon hand looms and converted into Osnaburgs or into jeans, the latter mostly of the so-called "butternut variety"; goods dyed with the butternut dye, which color gave the name to the Confederate uniforms.

There were a few considerable and successful mills devoted to both spinning and weaving; notably at Columbus, under the able supervision of William H. Young and John Hill; other mills at Augusta, the Graniteville Mill, and a very few others.

In 1870 the number of Southern spindles was nearly three hundred and twenty-eight thousand, gradually and slowly increasing, down to 1880, to five hundred and forty-two thousand. In this period looms were being added to many of the spinning-mills, and the change was going on from the homespun to the factory-made goods. It is only since 1880 that the additions have been made to the spindles of the South which have attracted so much attention.



No. 2.—Cotton Ginning.

According to the "Financial Chronicle," there were in the Southern States named, in the cotton year 1888–'89, two hundred and fifty-nine factories, averaging a little over five thousand spindles each, giving a total number of one million three hundred and forty-four thousand five hundred and seventy-six spindles in operation, with thirty-one thousand four hundred and thirty-five looms. The number of yarn spun was a fraction under No. 14—a gain in the fineness of the yarn, since my computation of 1880, of one number only.

If we deduct the few large mills, the average of the greater number is about four thousand spindles, ranging from one to six or seven thousand. The Southern consumption of cotton had increased from one hundred and eighty-eight thousand seven hundred and forty-eight bales in 1879–'80 to four hundred and eighty-six thousand six hundred and three bales in the last cotton year. In addition to the spindles in operation, a few have been added, and it is estimated by the "Financial Chronicle" that, on the 1st of September of the present year, there were one million four hundred and fifty thousand spindles in the Southern States, of which about one million are in the States of North and South Carolina and Georgia. The list given in the Baltimore "Manufacturers' Record" gives a greater number, but many mills in that list are only projected. I therefore adhere to the carefully prepared statistics of the "Financial Chronicle."

It is on the Piedmont plateau that you are to look for competition if anywhere in the Southern country. The mills will be built upon the foot-hills of the Appalachian chain; in the uplands rather than upon the lowlands of the South. On the foregoing statement there has therefore been a gain in the twenty years that have elapsed since 1869 in Southern spindles, mainly in the last ten years, of about eleven hundred thousand spindles; certainly very rapid progress. But now let us look at the other side.

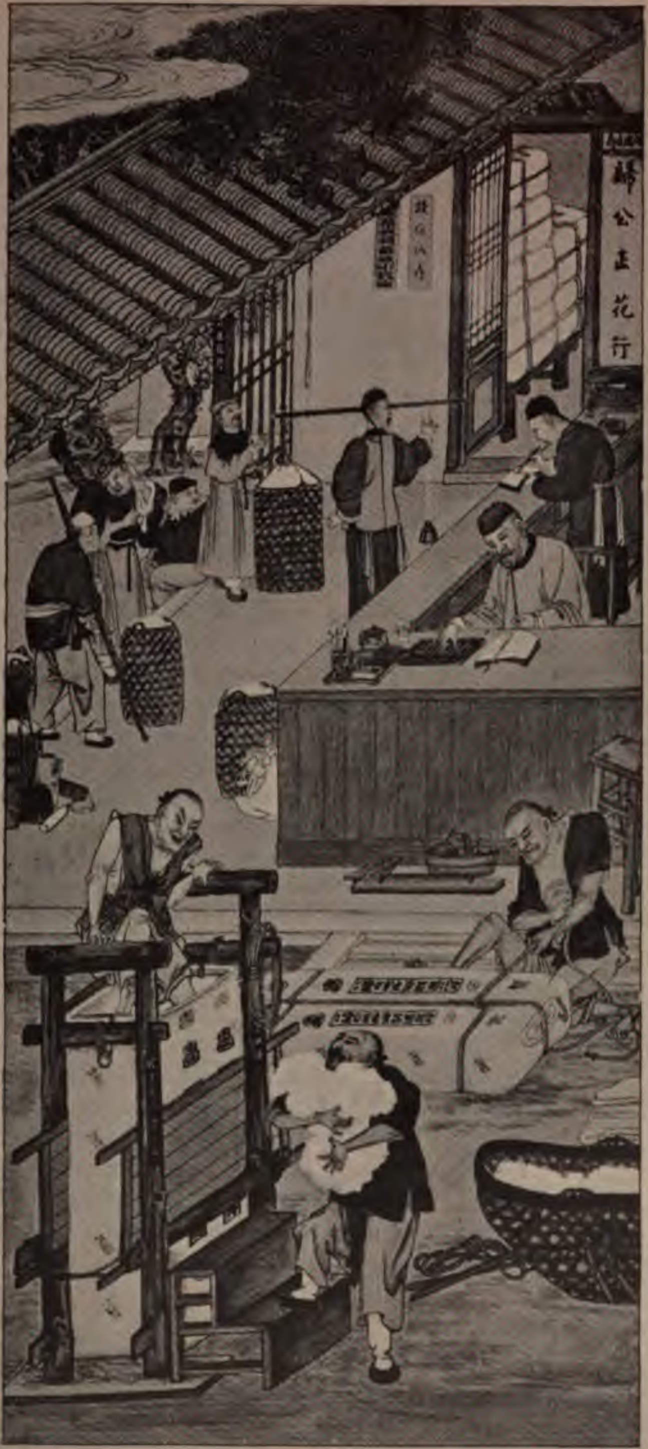
The gain in the population of these same States since 1870, on the basis of an estimate of our present population made by the Actuary of the Treasury Department, has been six million six hundred thousand. At the ratio of five persons to a spindle this absolute increase in the population of these same Southern States has called for the product of one million three hundred and twenty thousand spindles, or two hundred and twenty thousand in excess of the actual gain in the Southern factories. At the ratio of four and a half persons to a spindle, which is the present average, the gain in the population in these States requires the product of fourteen hundred and sixty thousand spindles. In these computations no cognizance is taken of the displacement of homespun fabrics.

If my computation is correct, that three and a half million people, who were clad down to 1870 in homespun fabrics, have changed to factory-made goods, in which estimate I am very much more than sustained by my correspondents, that change calls for seven hundred thousand additional spindles at the ratio of one to five, or seven hundred and eighty thousand at the ratio of one to four and a half.

These statistics, so far as they prove anything, therefore prove that while the spindles of the South have gained eleven hundred thousand since 1870, the demand of the South for cotton fabrics at the average of the country has increased in a ratio of more than double the product of their own increase of spindles; and I think all our observations tend to confirm these statistics.

A few sheetings and drills have been exported from the Southern factories and a few Southern goods have been sold in the West, but at the same time there has been a constantly increasing demand upon the North for medium and fine goods. These Southern goods which we have heard of from our salesmen were all made in the larger factories, which are well equipped with modern machinery—many of them being operated by men who would succeed anywhere—but they do not yet constitute a rule, nor must we forget or disregard the personal factor in dealing with this question. It is upon the personal factor, much more than upon proximity to the cotton-field, that the success of the Southern factory will depend. The advantage of position was only measured at a cent a pound four or five years ago. The freight from central Alabama to New England is now less than three quarters of a cent a pound. Very soon it will be down to half a cent; then what? The greater part of the Southern factories are, as you observe, too small to be economically worked, averaging but a fraction over five thousand spindles each. So long as these small factories are devoted to supplying Southern neighborhoods and Southern communities with checks, plaids, and heavy brown cottons, for which there is always a demand in that section greater than any other, they will succeed or fail according to the skill and aptitude of the owner or manager. It may have been observed that within the last few weeks there has been an overstock of these peculiarly Southern goods, and an effort has been made to check the production. Some of the Southern sheetings which have lately appeared in Northern markets must, I think, have been sold at less than cost.

I have referred to the personal factor as the main element in settling this question. In a small factory, wherever it may be, there must be such personal interest or individual ownership as to secure the necessary skill and judgment in the conduct of the work, and there must not be a set of stockholders who like cormorants swallow their dividends and demand them without regard



No. 3.—Baling and Pressing Cotton.

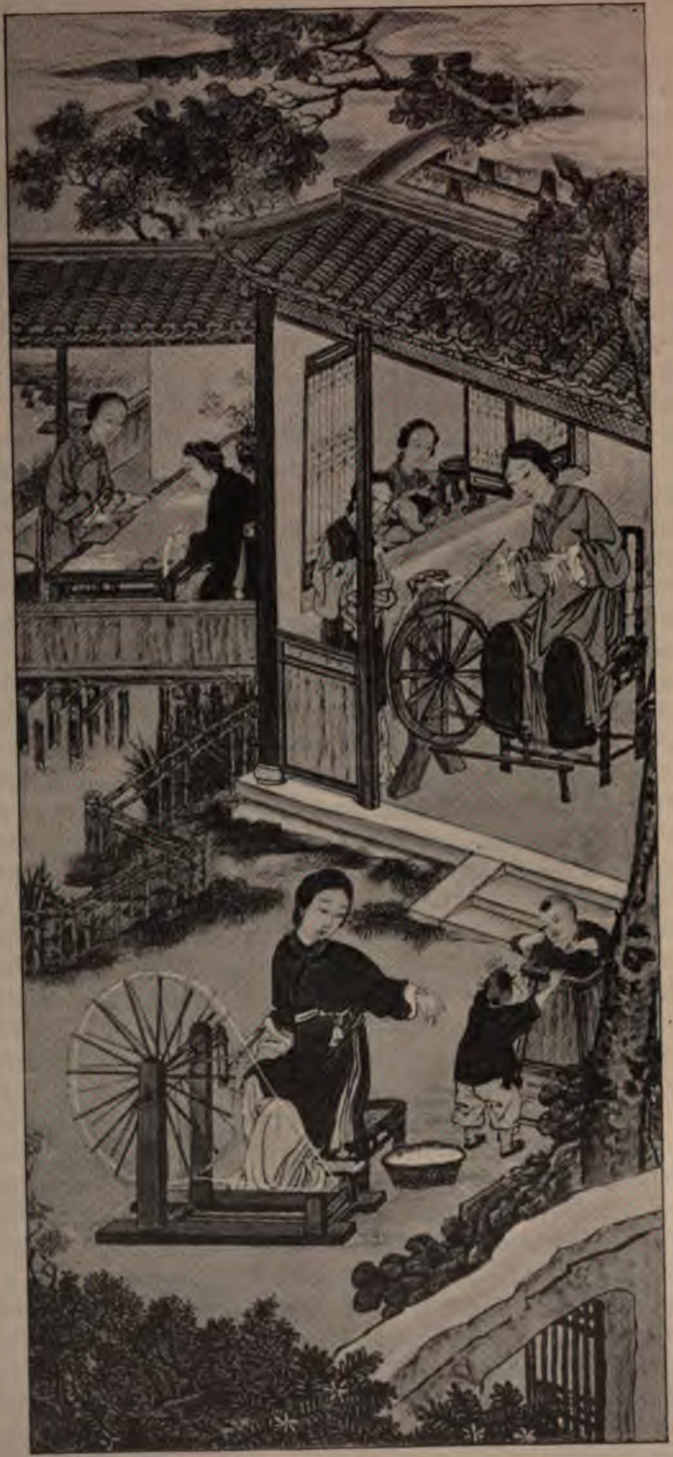
to the conditions of the market. In the larger mills, especially when owned by a corporation, the establishment must be of sufficient size to command the services of the most competent men, especially in the manufacturing department.

Does it not follow, from all these facts which I have submitted, that the competition of the Southern with the Northern factory, *down to this time*, has been more theoretical than practical? Is it not yet to begin, if it is felt in any considerable measure in respect to the home consumption of the East, the Middle States, and the West, aside from a very few heavy sheetings which have been sold in our Northern markets?

I must, therefore, again repeat the word of warning which I have so often given to my Southern friends: Beware of the isolated cotton-factory, and also beware of the small corporation; do not proceed upon the idea that, because the factory is near the cotton, it possesses any great advantage. Men who begin in a small way and who grow up with their business, or who have learned it elsewhere, may succeed, as many are now succeeding; but those who subscribe to the stock of an isolated Southern cotton-factory with the notion that a cent a pound or less advantage over the North in the price of cotton will assure success may get their experience at a high price when some other shrewder man buys the mill at a low price. In any event, under present conditions, not less than ten per cent a year on the cost of machinery should be charged off to depreciation. In many mills which I have visited, at least that portion of the machinery was going into the cost of the goods; in some cases without the knowledge of the owners.

Now, as to the future center or *situs* of the cotton manufacture. If you glance over the history of nearly all the principal arts, you will find that there has been a tendency for them to concentrate in special sections of given countries or states. Where and how such arts may originate may be to a certain extent a matter of chance; but, once established, it seems as if not only the manual skill and aptitude but the mental force of the whole neighborhood adjusted themselves to the special condition of these particular arts. Some one man invents or improves the machine, begins his work in one place, and makes money at it. This attracts attention; others gather in the neighborhood, and presently that place becomes the center of that specific art.

Go to Gloversville, in New York, away off on the high hills north of the Mohawk River: the whole population makes gloves and mittens. The art has existed there for so long a time that it has affected the language. If you are invited out to tea, when you are offered sugar and cream the hostess will ask you if you "take trimmings with your tea."



No. 4.—Cotton Spinning.

Go to Troy. One man invented nearly all the machinery on which the laundry-work is established, and all the laundries are called "Troy laundries." Then, since the laundry is the necessary adjunct of the shirt-factory, Troy and its neighborhood have become the center of the shirt, collar, and cuff manufacture. In this art the cutting and making of the shirt have been so perfected that it costs less to make the shirt than it does to do the laundry-work upon it and get it ready for sale; while the women who operate the sewing and ironing machinery earn higher wages than even your best weavers, because they make the shirts at the lowest cost. It is only the woman who sews poorly who is a poor sewing-woman.

Go to Foxborough, Mass.—the whole population makes straw hats; over at Taunton and in that neighborhood, tacks and brads; down in Connecticut, around Meriden and Waterbury, all the brass-work of special kinds. Go to Leicester Hill, the important occupation is making cards for your factories, with some offshoots in Worcester. Even a single art divides up. Lynn makes fine boots and shoes for women; Brockton, common boots for men; Spencer, heavy boots for men.

The Dundee orange marmalade is another instance. Why should orange marmalade be made in Scotland, and not in Spain, where the oranges grow? I think the immediate benefit to the people in Florida, Louisiana, and Georgia might be greater in the introduction of the marmalade manufacture rather than in that of the cotton fabrics. The capital of a single cotton-mill would establish a great many marmalade-factories, and, like the eggs, there might be no end to the consumption.

Now, for one reason or another, the art of spinning cotton centered in Lancashire, England, first starting in and around Manchester. It stays in Lancashire. Manchester remains the center of the trade, but the trend of the spindles is away from Manchester proper. The spinners have for some years built nearly all the new mills at Oldham and other towns, seven or eight hundred feet above the sea-level, on the crest of the ridge beyond which the moors stretch away to Scotland. They may not have known why they went there, but it is the point where the relative humidity of the atmosphere is most constant. The rainfall is only about half what it is in Massachusetts, but the relative humidity of the atmosphere is very high, and you are always looking out for a shower. The dry, bad days for spinning are when the wind is from the east—that is, the dry wind in England coming over the land.

They are building a ship-canal to Manchester at an enormous expense, estimated at ten million pounds, or fifty million dollars, in order to save the railway freight on cotton from Liverpool to

Manchester; but when the cotton reaches Manchester it will be taken over upon the cars and hauled up this heavy grade. The spinners did not make this change without a reason. What was it? Can there be any reason except the climatic conditions?

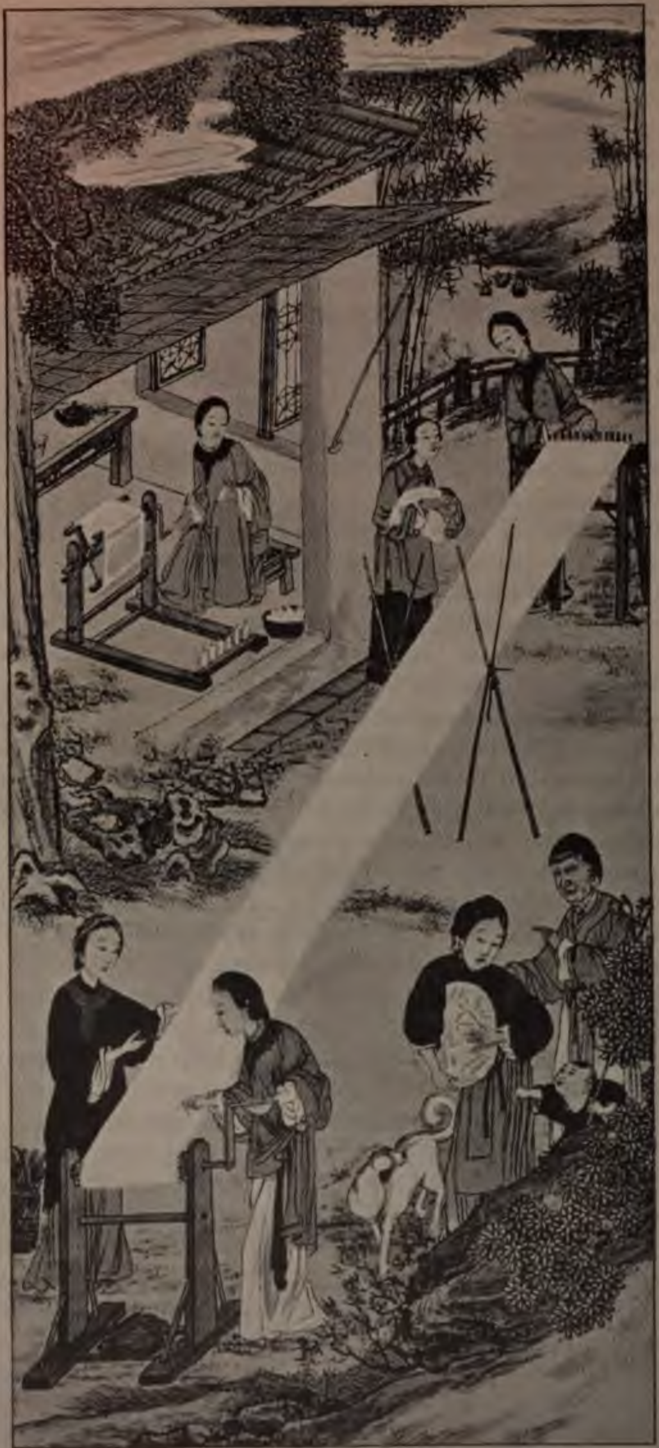
Our textile factories first gathered in centers where there was water power. It happened that Samuel Slater landed in Rhode Island, midway in the section where, I think, the cotton manufacture will stay. But water power carried many mills away up into New Hampshire, down into Maine, and elsewhere. That influence has gone by. Steam has taken the place of water power.

My judgment has been for a very long time that, barring one element which I will treat later, the greater part of the cotton spinning and weaving of this country will tend to concentrate along the south shore of New England, from New Bedford by way of Fall River, Narragansett Bay, and so on along the Sound, at the points to which coal can be carried in barges at very moderate cost, to which the cotton can be brought at diminishing rates of transportation from the South, and where the conditions of life are comfortable, the supplies abundant, and where all the subsidiary arts will gather or have gathered around the factories.

It is along this shore that the Gulf Stream exerts an influence somewhat like that which affects Lancashire. Although perhaps less in degree, the humidity of the atmosphere is more constant and more nearly consistent with the best conditions for spinning and weaving than it is in any other section of this country within my knowledge. I will not speak dogmatically upon this point, because I do not think we yet know enough of atmospheric conditions to be able to determine this question. It is one of the elements of the case. As this concentration takes place, as you so well know, the relative number of spare hands and the number of repair hands in each factory will be diminished; thus the general expenses will be reduced. The draft for help will be made upon the whole population, and the work will be subdivided in the way which is most conducive to the very closest economy.

To what extent weaving will be separated from spinning we have yet to see. I think that separation will go on as the work becomes finer and more dependent upon the changing fashion and fancy of the season than upon its quality for the sale of the product. That tendency is clearly apparent in the increase of fine spinning-mills in this section, in which no weaving is done. I have called attention to these points before.

Again, I am inclined to believe that any very rapid development of Southern cotton manufacture will meet a check from the yet more rapid progress of our Southern brethren in many other apparently minor branches of industry. These minor branches,



No. 5.—Reeling and preparing the Warp.

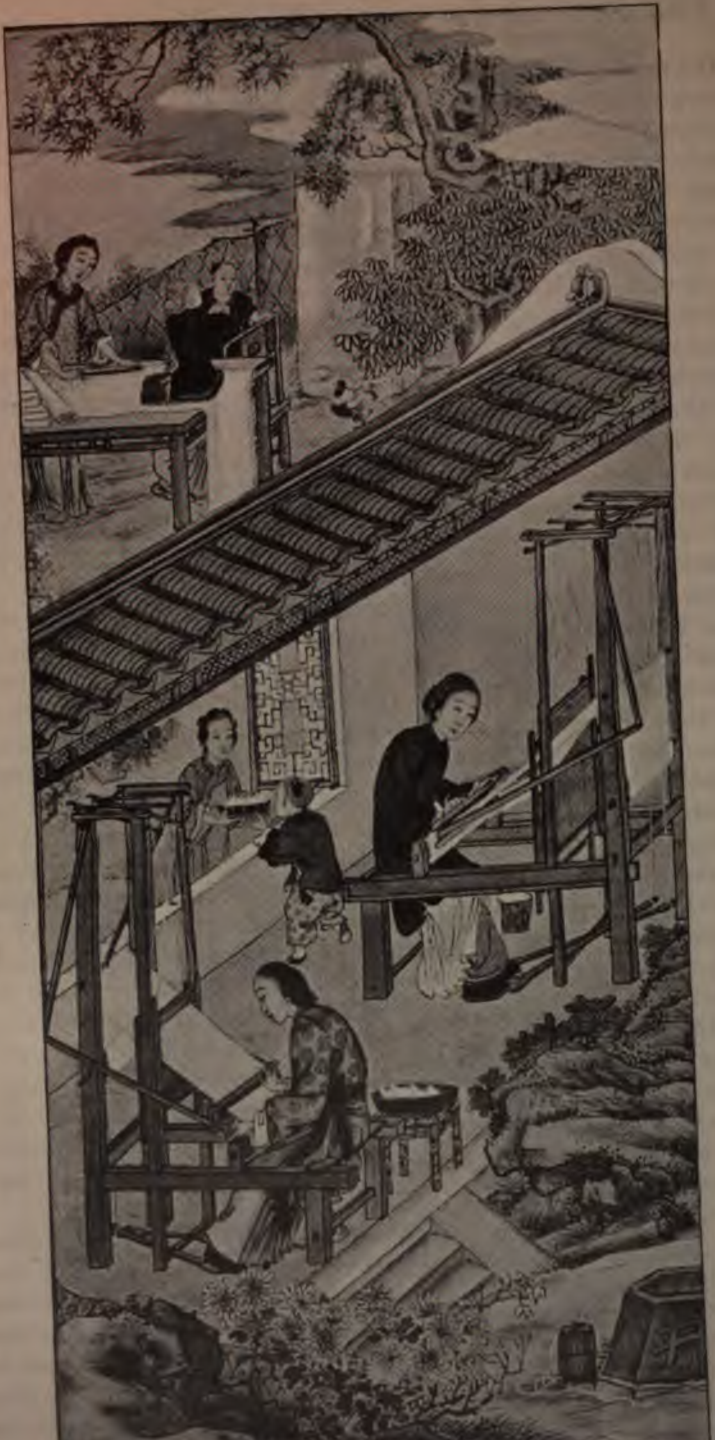
in the aggregate, are more important to the state and more conducive to diversity of occupation.

There has been up to this time a large reserve of unemployed people who could be drawn from the mountain sections of the South, where the factory-made fabrics have displaced the product of the spinning-wheel and of the hand loom, by which these people had been habituated to the textile industry. They are an excellent class of operatives, and, in passing from their isolated, narrow, and penurious lives on the hills to the factory and its surroundings, they have made a step in progress corresponding to that which occurred in New England when the farmers' daughters left the household and filled up the factories away back in 1840 and 1850. But it will be remembered that, with the progress of wealth and common welfare, all the farmers' daughters of New England have gone up and out of the textile factory into better paid branches of work, which are less monotonous, and which are more conducive to a satisfactory life.

The farmers' daughters earned from one hundred and fifty to one hundred and seventy-five dollars a year for thirteen hours of arduous work each day, in a low-studded, stove-heated, badly lighted, and non-ventilated factory. The French Canadians, who now in greatest number occupy their places, earn about twice as much per day and more than twice as much per hour, working ten hours per day, in the modern factory which I may presently show can yet be made a chosen sanitarium. As the earnings have advanced with the improvements in the processes and conditions of the work, the cost of the product has diminished, while the workman has received an increasing proportion and the capitalist a diminishing proportion of the joint product; but there was far greater opportunity for women to change from the factory to other branches of work in New England in former times than there will soon be at the South. We at the North were always a versatile people. We always had variety of occupation, whereas in the South nearly all the minor arts of life are in a very imperfect stage and in the very beginning of development; hence the change may be more rapid from the factory to other occupations.

Now, where it requires a thousand dollars or more of capital to set one woman at work in a cotton-mill, it only calls for two hundred or so to set one woman or man at work in a shoe-factory, in a clothing-factory, in a saddler's shop, or in any of the minor arts which may be counted by hundreds—each inconspicuous in itself, but the aggregate giving employment, even here in New England, to a force to which our factory population bears but the ratio of a small fraction.

I have stated the natural law which I think will be one of the



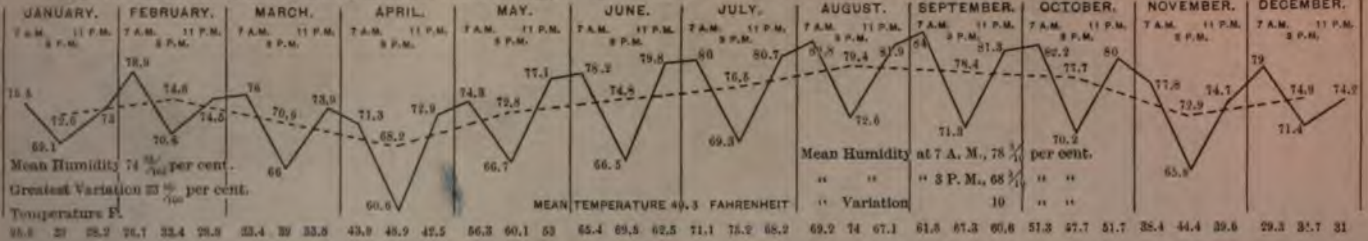
No. 6.—Cotton Weaving.

forces tending to concentrate the more important branches of the cotton manufacture along the south shore of New England. I hesitate to treat the subject of the influence of relative and absolute humidity upon cotton spinning and weaving, because none of us have yet any very accurate or scientific knowledge upon the subject; but, in order that a beginning might be made and the basis of an investigation might be laid down, I wrote to General A. W. Greely, giving the terms of the problem in a general way, and he has very kindly and carefully prepared tables for me which it might be judicious to incorporate in this report, giving the mean relative humidity three times a day—at 7 A. M., at 3 P. M., and at 11 P. M.—as well as the temperature. These observations are averaged separately for each month in the year, and in the accompanying tables the mean for five years, 1881 to 1885, is charted. My hypothesis had been that somewhere between the elbow of Cape Cod and Staten Island the cotton manufacture of the United States would gradually concentrate. That hypothesis, so far as relative humidity may be a factor in the case, is fully sustained by these tables. From General Greely's figures I have taken the mean temperatures at the same hours of the day and the mean relative humidity in New London, Conn., and Augusta, Ga. The conditions are shown by curves on these charts.

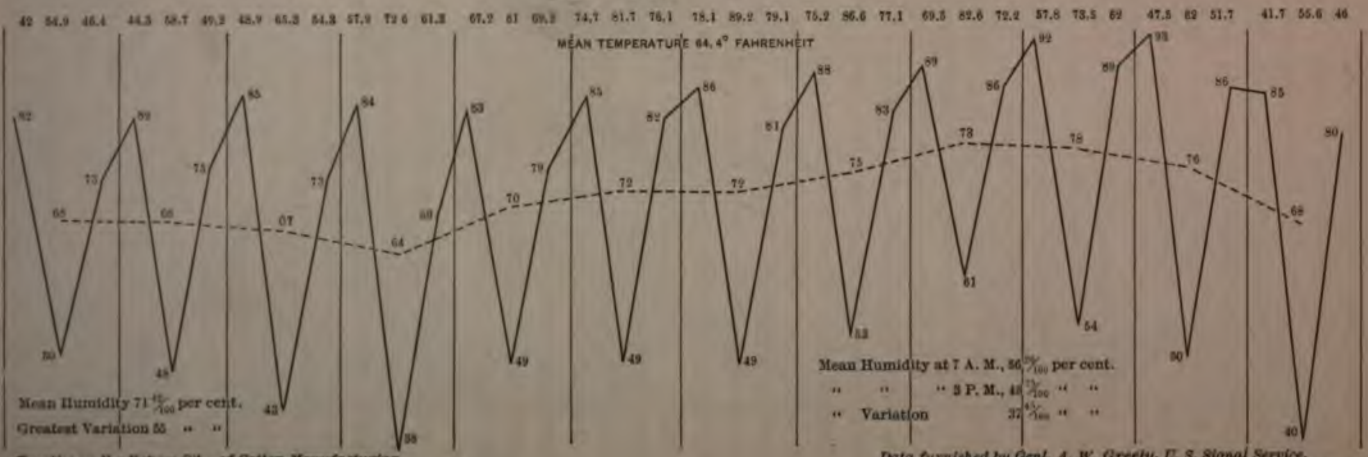
As is quite well known, the term "relative humidity" defines the ratio of the moisture in the air to the amount which would saturate the air at a given degree of heat. Saturation being called one hundred, this factor is represented on the chart by percentage. The absolute humidity, or absolute number of grains of moisture contained in each cubic foot of air, will of course vary with the temperature of the atmosphere, and the absolute humidity at the South may be greater than that of the North, owing to the higher degree of heat.

I think all will agree with me that spinning and weaving depend more upon the uniform conditions of relative humidity in respect to spinning, perhaps more on absolute humidity in respect to weaving, than upon almost any other climatic condition. General Greely remarks: "In locations distant from the coast there is a greater diurnal range of relative humidity in the atmosphere, owing to the heating effect of the sun's rays upon the atmosphere, causing the temperature of the air to increase more rapidly than the dew-point, thus making the air relatively dry during the working hours of the day. It is possible that this condition has tended to drive the cotton-mills toward the southern coast of New England, where *they are more completely covered by the vapor laden winds from neighboring waters, causing a reduced diurnal range in temperature and a more constant relative humidity.*"

RELATIVE HUMIDITY AND TEMPERATURE AT NEW LONDON, CONN., 1881 TO 1885, INC. AVERAGE PER MONTH OF THREE OBSERVATIONS PER DAY, EACH MONTH.

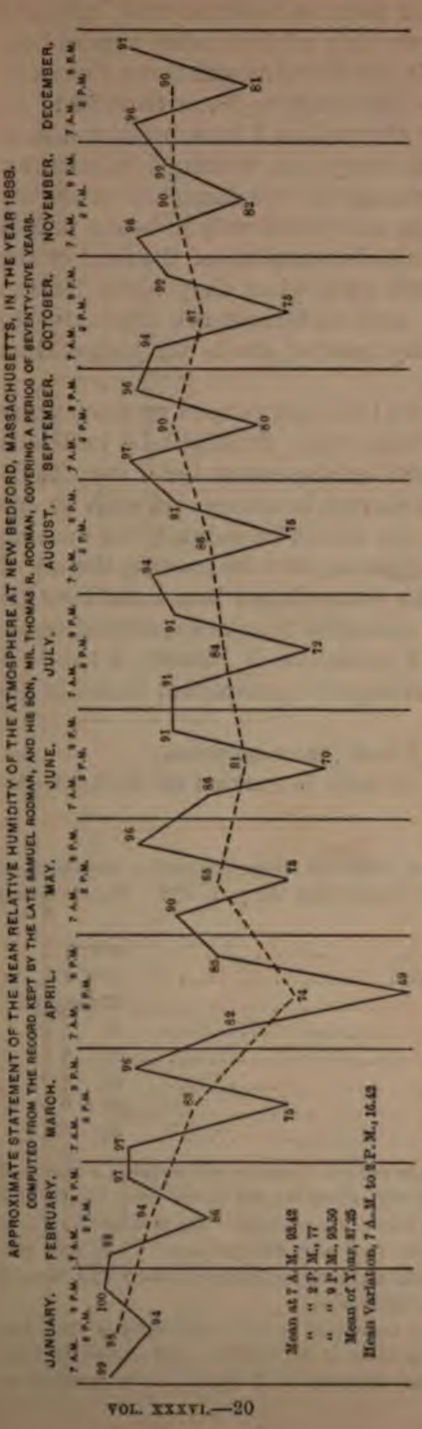


AUGUSTA, GEORGIA, 1881 TO 1885, INC.



Treatise on the Future Sites of Cotton Manufacturing.
New England Cotton Manufacturers' Association, Oct. 30th, 1889.

Data furnished by Genl. A. W. Greely, U. S. Signal Service.
Charted and Compared by Edward Atkinson, October, 1889.


APPROXIMATE STATEMENT OF THE MEAN RELATIVE HUMIDITY OF THE ATMOSPHERE AT NEW BEDFORD, MASSACHUSETTS, IN THE YEAR 1888.
COMPUTED FROM THE RECORD KEPT BY THE LATE SAMUEL RODMAN, AND HIS SON, MR. THOMAS R. RODMAN, COVERING A PERIOD OF SEVENTY-FIVE YEARS.

In the chart which I have referred to, I have compared the relative humidity of the atmosphere at New London, Conn., with that of Augusta, Ga., from General Greely's tables, and I have added the data of New Bedford, Mass., from the private records which have been kept for a very long period by Mr. T. R. Rodman and his father. I have also compiled some data relating to Atlanta, Ga.

The general results derived from these two charts prove that the mean temperature of Atlanta is 12¾° Fahr. above that of New London, with 13¼ less per cent of relative humidity, and subject to a vastly greater variation day by day. Augusta, perhaps the principal center of the cotton manufacture of the South, yields a little different result: the mean temperature of New London through the year is 49¾°; at Augusta, Ga., 64·4°, a difference of a little over 15° in heat. The mean relative humidity at New London is 74·53 per cent; the greatest variation in the year, 23·4 per cent; the mean variation, 10 per cent. At Augusta, Ga., however, the mean relative humidity is 71·42; the extreme variation 55 per cent, and the mean variation 37·45 per cent in relative humidity, or nearly four times as much as at New London.*

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* Since this paper was written, through the action of the New Bedford Board of Trade, Mr. R. C. P. Coggeshall has been

Now, I think no one would care to attempt fine spinning under a hot sun where the humidity of the outer atmosphere changed between seven o'clock in the morning and three o'clock in the afternoon from 84 per cent of moisture to 38, or from 93 to 50. Bear in mind that the variation charted, as I have presented it, is the mean variation of each and every day, averaged by months. It will be observed that this change in the humidity of the air makes the heat more comfortable and more easy to bear; that is the reason why our Southern friends complain of the heat of the summer as compared with their own when they come North; but, whether these conditions and variations are conducive to spinning and weaving cotton, my hearers are better judges than I am.

It may be remembered that we took this subject up some years ago, but I do not think it was then ripe. It might be judicious for the association to make some arrangement for a very thorough and complete study of this matter, in connection with a very visionary proposition which I am about to submit, for making use of freezing apparatus in tempering and controlling the air of factories. I was unable to take this subject into consideration until very lately, and I need to apologize for the superficial treatment which I have given it. I introduce it because I think it may be a most important and perhaps the paramount factor in determining—

1. Where the coarse work, 13 to 20, may be done.

2. Where the medium, 20 to 40, may be carried on without disadvantage.

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enabled to furnish the figures by means of which the mean temperature and the mean relative humidity at New Bedford have been compiled for the year 1881. The results are as follow:

Mean temperature, dry bulb	48·9° F.
Wet bulb	46·4° F.
Mean relative humidity, 7 A. M.	90 per cent.
Mean relative humidity, 2 P. M.	74 "
Mean relative humidity, 9 P. M.	90 "
Mean of the year	84 "
Maximum during the year	100 "
Minimum during the year	60 "

I have also received readings for the mean relative humidity of Prestwich, a suburb of Manchester, in Lancashire, but not situated high above the sea on the crest, like the Oldham district, Prestwich being only 294 feet above the sea-level. The readings for 9 A. M. show a mean relative humidity of 84 per cent; for 9 P. M., 87·6 per cent. There is no midday observation. The variations morning and night correspond very closely with those of New Bedford, the relative humidity being a little lower.

I am led to believe, from all that I can learn, that so far as atmospheric conditions constitute a factor in cotton-spinning, the conditions of the southern coast of New England, where the climate is affected by the moisture from the Gulf Stream, are as favorable as those of Lancashire to any kind of work.

3. Where the medium fine work, 40 to 80, ought to go.

4. Where the finest, 80 to 200, or upward, must go, unless we can prepare a special atmosphere for each class of work.

I looked over a few numbers of the reports of the Royal Meteorological Society of Great Britain, and, while I find there are great variations in the relative humidity of the atmosphere in different parts of Great Britain, the changes are not as great as they are in this country, even between morning and night. I can not find any midday record as yet. I have sent for one.

Neither have I been able to find a record of a manufacturing town, but I should infer that the conditions of Buxton, one of the stations, might correspond to Oldham, Preston, etc. Buxton is, as you know, an inland health-resort on the peaks of Derbyshire, not far from Manchester, about a thousand feet above the sea-level, not much higher than Oldham, and facing the Gulf Stream. The mean temperature of the year at 9 A. M. is 44·15°; 9 P. M., 42·5°; extreme temperature, 1888, 79·2°; mean relative humidity at 9 A. M., 90 per cent; 9 P. M., 92 per cent; highest point, 95 per cent; lowest, 80 per cent; variation, 15 per cent. No wonder it rains easily where the atmosphere is within less than 10 per cent of the saturation point almost all the time.

Since dictating the foregoing statement, Mr. Clayton, of the Blue Hill Observatory, has kindly computed the mean relative humidity of the atmosphere at Greenwich, England, from data within his possession, for the years 1884, 1885, and 1886. The mean of the hours 7 A. M. and 3 P. M. is 87 per cent; the extreme variation, from 95 per cent of humidity at 7 A. M., October, 1886, to 49 at 3 P. M., August, 1884. As I have before stated, the changes at Greenwich are very much greater than they are in Lancashire. I hope to procure figures for Lancashire, which I have sent for, before this report is published.

I have thus given some of the apparent advantages of New England over the South. I will now present some of the advantages of the Piedmont plateau, of the foot-hills, and of the upland country of the South, for the manufacture of coarse fabrics, even though the extreme of heat in the summer months is less conducive to continuous work throughout the year than the extreme of cold of our winter climate, and even though the humidity, both absolute and relative, of that section of our country is very much more variable than upon the south shore of New England.

While pointing out the advantage upon coarse numbers, I also call your attention to the indications that the demand of this country for coarse and unbleached fabrics is relatively diminishing while the consumption of the finer bleached and printed fabrics is relatively increasing. As soon as people can afford to wear a "b'iled" shirt rather than a gray cotton, or a fancy satine rather than a common print, they will have them and they can now well afford to pay for them.

I was under the impression until I took up this subject that the North had a positive advantage in pure water for bleaching and finishing, for the reason that all the rivers south of the lower margin of the glacial drift, which ended at the mouth of the Delaware River, are muddy or turbid during a large part of the year, and there are no ponds or lakes of clear water; hardly any of any kind in the cotton States. My correspondence with Mr. John Hill has disposed of this superficial doubt by calling my attention to the facility with which very pure and very soft water may be derived either from abundant springs or from artesian wells. There is no point to be made against the South on bleaching and coloring.

Again, so long as the supply of native operatives suffices, there may be a great field hardly yet occupied, in the production of coarse rather than of fine cotton fabrics, without trenching or taking away from us any part of the work which we can do in the best way. I think our Southern friends may develop a very important branch of textile industry in spinning and weaving below No. 20.

It will be observed that this whole problem turns upon an average advantage claimed by the South over the North of about one cent a pound in the price of cotton. This present advantage, whatever it may be, will be reduced whenever the volume of Southern railway traffic becomes greater and freight charges are cut down; but it may always be a considerable point on heavy goods. There is not, however, the full difference of the freight between the North and the South. Very few mills can supply themselves with cotton, even in the South, from the immediate neighborhood; and, when cotton must be baled and put upon cars for transportation, the local rates are apt to be quite heavy for short distances.

The advantages claimed by the South on account of the longer hours of work can not be admitted. In the first place, they will soon be shortened, either from choice or necessity; and, in the second place, I doubt if any very skillful manager now thinks that high speed can be profitably maintained more than ten hours a day.

Again, it is claimed that wages are lower in the South than in New England. This is true. The rate of wages is lower, but I doubt if the cost of labor is any lower, if as low. It may be in a very few of the best managed mills, but in taking the census of 1880 I made a very careful computation of the proportion of hands to spindles and looms, and after making every allowance for difference in yarn, in number, and in quality of mills, I found that there were substantially two hands employed in the South against one in New England, and this computation has been sustained by my observation in such mills as I have visited.

Now, it is well known that the more hands the more waste, the more want of discipline, the more lack of good work. In a recent report on Russian spinning by our friend Mr. Dobson, who spoke to us on carding-engines, he reaches identically the same conclusion in comparing Russia with Great Britain.

Doubtless there has been great improvement in Southern methods since 1880; with increased efficiency, the number of hands decreases; but the wages or earnings rise, and will continue to do so, until they become equal to what we pay.

I am, therefore, confident that we may hold a long lead, and that we need not yet borrow trouble from any competition in Southern factories after they have learned to keep their depreciation account, and after they cease to run the risk of bankruptcy by working their machinery into their fabrics without charging it off.

I might here rest my case; but I will venture to give a few more facts bearing upon this subject.

There is one development of science which may render the cotton-factory entirely independent of climatic conditions. One of the visionary theories which I presented many years ago has not yet been put into practice in any great measure. I suggested preparing the atmosphere which is to be used as an instrument for taking away the moisture from the slashers by carrying it into the sizing-room through a chamber filled with ice. Since that date there has been immense progress in the art of freezing. Frozen carcasses of mutton are now carried from Australia to England. When the trade was first established, the owners of the Victoria Docks in London prepared chambers which were cooled by ammonia machines sufficient to hold 3,200 carcasses. There were four chambers of 12,000 cubic feet each, supplied by a ten horse-power engine, delivering 10,000 cubic feet of air below the freezing-point per hour. There are now on the Royal Victoria Docks sixty chambers of 240,000 cubic feet capacity, supplied with 370,000 cubic feet of air below the freezing-point each hour, by a three hundred and twenty horse-power engine. These chambers will hold 80,000 carcasses of mutton at one time.

I lately put a very commonplace question to the F. W. Wolf Company, of Chicago, manufacturers of freezing machinery. I asked them, as if it were an every-day ordinary matter of business, at what price they would put down an ammonia plant suitable for maintaining the temperature of a cotton-mill three hundred feet long, one hundred feet wide, twelve-foot post, four stories high, at a uniform degree of 70° Fahr. throughout the summer. To which they replied:

"Yours of the 9th instant is at hand. We can furnish you one of our No. 5 Linde refrigerating machines, having a capacity equal to the melting of twenty-five tons of ice in twenty-four hours" (this is the standard of the effectiveness of this machinery).

"With this machine the temperature of a spinning-mill of the size given may easily be kept at 70° Fahr. We will furnish the whole plant, including the necessary cold-air pipes, ventilators, etc., for the sum of fifteen thousand dollars."

I have written to them to know what would be the cost of operating this machine.

Cotton manufacturers may yet be obliged to convert their mills into sanitariums, to which they may attract, not perhaps the most attractive women of the land, but those most capable of being attracted by attractive conditions of work, by offering them the most equable and pleasant temperature, most conducive to health, which they can find in any occupation open to them. This will only be in the line of all the other improvements which have been made in mill operation.

All progress consists in alleviating the noxious and arduous conditions of labor, in enabling the workmen to increase the product with lessening effort, in shortening the hours of labor, in raising the rate of wages, and in reducing the cost of production. In this line of progress there is room and to spare for us all. We of the North may retain what we possess and we may continue to gain in the finer branches of the textile arts. At the same time we may welcome our Southern friends in their effort to supply themselves and to share the wider markets of the world, which may soon be open to us by the removal of the duties on the crude or partly manufactured materials which are necessary in the construction of our factories and in the processes of our industry.

I am conscious that I have covered too much ground. My time does not suffice for condensing what I have to say. I have given my manufacturing friends an optimistic view of the future of cotton-spinning in this country. Bear in mind that for any immediate application these figures are all rubbish. There is at the moment an overstock of Southern goods, and apparently an oversupply of heavy goods and of colored goods in the North as well. Therefore, unless they act upon old Billy Gray's principle of moving against the evidence, and operating always when appearances are most adverse, they will conclude that, although we may require five million spindles in the next ten years, the man who puts in a foundation next year may make a great blunder.

I have ventured to suggest to the promoters of the Exhibition of 1892 that a considerable part of that undertaking shall be devoted to object-lessons in the development of the arts of life, taking as my example spinning and weaving. The distaff, used as it was in the days of Homer, may still be found in use in northern Italy. The hand loom and the spinning-wheel of prehistoric type are presented in these pictures from China. Other methods of spinning, and other wholly different forms of hand loom carried in the hand for weaving narrow stripes, may be brought from central Africa, and so the whole history of the textile arts may be gathered in one place, either by obtaining examples from different parts of the world, or any one may study the whole development of the cotton manufacture if, before it is too late, he will visit the heart of the eastern Kentucky mountains, and from there journey by way of the neighborhood mills of the South to the great factories of the North.

PUBLIC SCHOOLS AS AFFECTING CRIME AND VICE.

By BENJAMIN REECE.

THE political and material progress of the nineteenth century have been truly wonderful. The past year was memorable as the anniversary of the inauguration of the first President of this great republic, and what a record of bewildering changes do those hundred years unfold! Thirteen States have been increased to forty-two, and the center of population has moved back from the seaboard to a point nearly a thousand miles in the interior. The lakes of the North have given birth to gigantic commercial marts, which rival in trade, wealth, and culture those seats of ancient pomp, and empires and cities of mediæval grandeur, which flourished on the shores of the Mediterranean.

The affairs of the remotest portions of this immense domain, together with the world's more notable events, are regularly recorded in the daily press and read the morning following at the breakfast table. The traveler boards the train at New York, having telegraphed his friend in Chicago to meet him at the station twenty-four hours later, giving the exact minute of his arrival at a place a thousand miles distant from his starting-point. A change of cars is made for San Francisco, and after riding over hundreds of miles of fertile prairie covered with growing crops, crossing wide rivers spanned by bridges which fifty years ago were deemed impossible, across boundless plains where countless herds of cattle and flocks of sheep are fed, and passing through vast mountain ranges pierced by tunneled passage-ways, the traveler reaches his destination upon the shores of the Pacific Ocean the very minute of the day announced to him by the ticket agent in New York.

If we turn our thoughts seaward the development is no less remarkable; for the long, dangerous, and uncertain voyages once made by sail to Europe are now conducted with almost equal regularity and safety, and the mammoth steamers of the Clyde accomplish in days the trips which formerly took months to perform, and, within an hour of the safe landing of the passengers, the electric telegraph through the media of lines and ocean cables discloses to friends at home the news of their safe arrival. In the political world the progress of the century has not been less marked. England, which during the reign of George III so persisted in tyrannical measures of taxation as to push its American colonies into a successful struggle for freedom, has extended the utmost liberty of action to its remaining American dependencies and Australian colonies; so, when Britain was threatened with hostilities in the East, she moved to the scene of action the dusky warriors of her Indian empire, while the impetuous youth of her distant colonies volunteered to do her service on the desert sands of Africa or in the mountain fastnesses of Asiatic Russia. Within a generation has been witnessed the voluntary liberation of the serfs of Russia, the slaves of Cuba and South America, and in our own country chattel slavery was forever extinguished by the sword.

The growth of liberal ideas and the love of liberty have been very marked. Hungary has been granted the right to legislate upon its own affairs; a republic has been established in France, and in spite of dire forebodings and prophecies of evil it has withstood every shock and weathered every storm; while the greatest of English parliamentary leaders, in his declining years exhibiting all the ardor of youth, combined with the vigor of robust manhood and the matured wisdom of old age, has brought his fellow countrymen to a recognition of Ireland's wrongs, and is moving the English masses to extend the principles of Anglo-Saxon liberty and home rule to Ireland, which for centuries has been inthralled. But volumes would be required for the mere enumeration of the growth and development which have come with extended knowledge and the more general schooling of the people. Is it any wonder that statesmen unstintingly provide for the wants of our public schools; that divines dwell with rapture upon the blessings they have brought us; that political orators eulogize them as the foundation of our prosperity and the mainstays of our liberties; that agitators vehemently demand an extension of their benefits; or that the people feel an honest and unquestioning pride in this governmental institution of their own creation, which has promoted religious tolerance, extended the bounds of political liberty, enhanced the nation's wealth, and contributed so largely to its power?

It, however, is further claimed, and almost universally allowed, that the instruction of our public schools serves to ennoble the emotions and to moderate the passions, to regenerate the viciously inclined, and to correct and subdue the tendency to crime. Devoutly as such a result is to be desired, the facts unhappily flatly contradict the theory, and unless the glaring inconsistencies are reconciled, and contravening evidence is satisfactorily explained, the claim must be abandoned as unfounded.

At a session of the National Prison Congress, held in Boston during 1888, Mr. Brooker, chairman of the Board of Directors of the South Carolina Penitentiary, having made the statement that of a thousand convicts in the State not more than fifty were whites, it was asked by a delegate, "What is the condition of the education of the colored people?" To this question Mr. Brooker made the following reply: "Before emancipation, the colored people had no opportunity for education. When made suddenly free, all negroes were illiterate and ignorant. Since that time a young generation has grown up, and of them a very considerable number are well educated. *But it is a fearful fact that a large proportion of our prison population is of the educated class.* This is so much the case that the idea has become prevalent that to educate the negro is to make him a rascal. But this idea is of course superficial, and does not find lodgment in the minds of thoughtful men. I am totally averse to it myself, and think that all reasonable means should be exerted toward their enlightenment and education." ("Proceedings of the National Prison Association," 1888, p. 72.)

The constructing engineer is to our industrial, commercial, and mechanical development all that the statesman and student of sociology is to our moral, social, and political progress. If in a convention of engineers a verified report had been made that bridges of accepted form were showing visible signs of weakness, the report would have been listened to with the greatest consternation and dismay. The convention would have instituted the closest inquiry and most searching examinations; it would have stopped the construction of such bridges until the causes of failure had been determined and the remedy ascertained, and failing in this the construction of such bridges would have been permanently abandoned and more perfect structures substituted.

But here was the most astounding fact that in South Carolina, which in 1880 had more than half its population returned as illiterate, the educated negroes furnished a large proportion of its criminals, pressed upon a representative body of philanthropists, publicists, and statesmen, and it did not so much as provoke a comment, while the author of the statement boldly affirmed his unshaken faith in a theory the facts of which he had himself impugned. What deference should we pay to thought unless based upon correct observations, and of what utility are facts and experiences unless their teachings are heeded and their meaning properly interpreted?

In his "Political Science" Woolsey tells us that "the fall of the Roman Empire was an effect of a moral ruin." Yet all will admit that Rome and the other civilizations of antiquity were richer and more learned in the time of their decay than during the period of their infancy and growth; but the moral correlative being wanting, they tottered to their fall.

Just look at the records of our mentally and morally deranged as exhibited in our statistics of insanity and crime and vice, and they alone are enough to cast doubt upon the claim that a public-school education for our illiterates is sufficient to insure a decrease of mental and moral delinquency. For it remains to be explained why, in the decade ending with 1880, population having increased thirty per cent and illiteracy only ten per cent, a relative decrease; that the number of criminals during the same period present the alarming increase of eighty-two per cent, while of insane persons there appears the enormous addition of one hundred and forty-five[*] per cent?

Can it be possible that with greater educational facilities there is to be increased crime, and that every enlargement in the seating capacity of our schools is to be followed by a larger corresponding demand for insane accommodations, and additional felons' cells? Perish the thought! Yet if the instruction of our common schools subdues the tendency to crime, why is it that the ratio of prisoners,[†] being one in 3,442 inhabitants in 1850, rose to one in every 1,647 in 1860, one in 1,021 in 1870, and one in 837 in 1880; while, upon the authority of the Rev. S. W. Dicke, the amount of liquor consumed per capita was three times as great in 1883 as in 1840?

One naturally looks to the large and constant influx of foreign immigrants as a partial explanation of this growing disproportionate increase of crime; but the facts deny the hope, for the great increase is to be found among the native-born. The Rev. F. H. Wines, who conducted this branch of the "Tenth Census Report," says that, while in 1850 the ratio of foreign criminals to population was five times that of the native-born, in 1880 the ratio was only two to one; and if we deduct the commitments for disorder and immorality, the ratio of foreign criminals is but little in excess of that for native whites. So clearly is this indicated by facts and figures, that Mr. Wines arrives at the conclusion that "the foreign disregard for law shows itself far more in immorality and disorder than in dishonesty and violence."*

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[*] It is but fair to state that this enormous increase of insanity has led the compiler to question the accuracy of the returns of insane persons made in 1870, yet it is admitted that, after making every allowance, the ratio of increase is out of all proportion to that of population. (See page 1660, "Compendium of the Tenth Census.")

[†] "Proceedings of the National Prison Congress," 1886, p. 134.

An examination of the "Compendium of the Tenth Census" of the United States discloses some novel and threatening facts. The illiterates of the United States comprise seventeen per cent of the total population. The morally and mentally deranged, as shown by the number of criminal and insane persons, bear the ratio of one to every 332 inhabitants. The general average of illiteracy is exceeded by every one of the original slave States with the exception of Missouri, but the average ratio of the mentally and morally unsound is only reached in the State of Maryland. South Carolina, which shows the highest percentage of illiterates, viz., 55$\frac{4}{10}$ per cent, presents the lowest average of any State in the Union as regards insanity and crime, having but one delinquent in every 568 inhabitants as compared with one in every 167 in California, one in 205 in Massachusetts, and one in every 222 in the State of New York. With the single exception of the State of Maine, every Northern State east of Indiana has a larger ratio of insane and criminals than the average for the Union, while the States west of Ohio, those on the Pacific slope excepted, fall below the general average.

If we measure the extent of unrecorded vice by the proportion of saloons to population, the showing is no less remarkable. The "Report of the Commissioner of Internal Revenue for the Year 1887," page xxxiii, shows that, for the entire country during that year, a retail license for selling liquor was granted for every 329 inhabitants. Of the fifteen States showing more than the average number of illiterates that ratio was only exceeded in the State of Louisiana; while the lowest average in the country was to be found in Mississippi, which, with 49$\frac{6}{10}$ per cent of its inhabitants returned in 1880 as being illiterate, supported but one saloon for every 1,695 persons. Even the prohibition States of Maine and Kansas secured licenses for the sale of intoxicants at retail to an extent only equaled by four of the fifteen super-illiterate States. The proportion of saloons to population throughout the fifteen super-illiterate States is one for every 700 inhabitants, while of the other States California heads the list with one to every 99 persons, New Jersey coming next with one license to every 171 inhabitants, followed closely by New York with one to every 179.

The table which follows presents some disquieting facts, which should serve as a salutary warning to those who expect to find in mental stimulation an equivalent for moral growth and culture:

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* "Proceedings of the National Prison Association," 1888, p. 255.

Compiled from Compendium of Tenth Census, and other official sources.

	Illiterates ten years of age and over.	Assessed valuation per capita.	Ratio of insane and criminal.	Ratio of saloons to population.‡
	1880.†	1880.†	1880.†	1887.
	Percentage.	Amt. per capita.		
Fifteen illiterate States*.....	$40\frac{4}{10}$	$145	1 in 402	1 in 700
Northern States west of Ohio .	7	297	1 in 379	1 in 308
Northern States east of Indiana.	$5\frac{3}{10}$	551	1 in 265	1 in 227
Average	17	$340	1 in 332	1 in 329

The table unmistakably shows a greater per capita of wealth where the fewest illiterates are enumerated, but it no less clearly shows that this augmentation of riches has been accompanied by increased insanity and crime and more wide-spread vice.

But we need not confine ourselves to the general statistics of the United States, for the records of New York present similar conditions, which can be analyzed more in detail. The "Annual Report of the Superintendent of the New York State Prisons, 1886," records that the prisons of Auburn and Sing Sing contained 2,616 convicts; of these, 1,801 are credited with a common-school education, 373 are classed as being able to read and write, 19 are returned as collegiates, 10 as having received classical and 78 academic educations, 97 as being able to read only, and 238 as having no education. Is it not contrary to our most confident predictions and undoubted expectations that the common schools should furnish eighty-three per cent and the colleges and academies over four per cent of the inmates of Auburn and Sing Sing?[*]

When it is remembered that the detected illiterate generally finds his way to prison, while the highly educated or well-to-do are frequently saved by friends, who compound the felony to escape exposure and consequent family disgrace; that many are saved from conviction by the ability of counsel whose services are far beyond the means of the illiterate poor, while still many others escape into voluntary exile to avoid imprisonment, it will be seen that even the figures given inadequately portray the extent of crime which, in strict justice, is properly chargeable to the educated classes. Of the prisoners of Auburn and Sing Sing it is further noted that twenty per cent were total abstainers from intoxicants, showing very clearly that a perfect mastery of self is by no means necessarily allied with an honest regard for the rights and property of others.

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[*] Includes all States having a percentage of illiteracy above seventeen per cent, the average for the entire country.

[†] Computed from tables in Compendium of the Tenth Census.

[‡] Retail licenses issued by United States in 1887, taken from Report of Internal Revenue Commissioner. Population for 1887 from "World Almanac," 1888.

[*] The report for Clinton Prison simply classified the prisoners received during the year, and it could not be included with Auburn and Sing Sing, which classify all inmates.

But if the education of the masses is accompanied by no diminution of vice, crime, and insanity, what shall we say of the effect illiteracy may have upon our institutions by the abuse or misuse of the suffrage? The following extract from the address of the Rev. J. C. Hartzall, delivered before the National Education Assembly at Ocean Grove, in August, 1885, which, with other extracts, is incorporated in the speech of Senator Blair on his Educational Bill, delivered in the Senate, February 8, 1886, presents a fair example of the rather extravagant statements often made by publicists and statesmen concerning the dangers attending the exercise of the elective franchise by illiterate voters. The reverend doctor thus appealed to the Assembly: "I simply call your attention to what may be the injurious effect of their (illiterates) silent action at the polls. The members of our respective political parties believe in the rightness of their principles, and seek to make their appeal to the reason and the consciences of the people; but the figures disclose the alarming fact that in eleven States these illiterate voters outnumber the votes cast in the last presidential (1884) election by either of the political parties. Thus, should they unite under any strong, impassioned, successful leader, they would have absolute control of legislation and offices in those States, and of the election of twenty-two members of the United States Senate."

Only a moment's thought is necessary to expose the folly of such ill-founded fears, for the suggested peril is contravened by the very conditions set forth as dangerous, as the inability to read and write affords a complete and absolute bar against the possibility of such concerted action; for what means of communication are to be employed to unite, for a single purpose, the illiterates of eleven States, who can neither read letters, circulars, documents, nor newspapers, and, still further, are unable to write answers in return? It requires the most perfect organization, careful canvass, and the expenditure of vast sums of money, to bring out a full vote where conditions are the most favorable for it, in the enlightened and thickly settled portions of the Union, and only where States are very evenly divided is the organization so perfected, at great cost, as to make a full vote possible.

But the election returns themselves are sufficient to prove that the voters in the illiterate States adhere more closely to the two great parties which are said to "appeal to the reason and consciences of men" than do the voters of the States affording the best facilities for the education of the masses; and in the election referred to in the address, the fifteen super-illiterate States combined cast but twenty-five per cent of the Greenback vote polled by the single State of Michigan, while in the late presidential election the same fifteen States cast but ten per cent more Labor-Union votes than were cast in the State of Kansas alone, and nine of the super-illiterate States fail to record the polling of a Union-Labor vote.

Far from mental stimulation being essential to moral development, the most perfect order and deepest sense of justice are often found associated with the densest ignorance among the lowest races of humanity. Turn your attention to the Papuan-Islanders,[*] the Veddahs,[†] the Dyaks of Borneo,[‡] the Fuegians,[#] and other barbarous races which, in the absence of rulers or organized societies, with no learning and but little acquaintance with even the rude arts of many primitive people, have developed the highest degree of tribal piety, integrity, chastity, and regard for covenants almost unknown to civilized man. The testimony of early travelers proves conclusively that intense poverty and deep ignorance are by no means incompatible with honesty, integrity, and virtue.

The table shows that where the extremes of poverty and wealth prevail, as in the Eastern States, there is found a maximum of moral and mental derangement, as exhibited in insanity, crime, and vice. Where wealth is more evenly distributed, as in the Western States, there are noted less insanity and crime, but almost as high a ratio of saloons as in the East. In the Southern States, although having a low per capita of wealth, yet the mental and moral forces of development are more nearly in adjustment with the material environment; hence the average of crime and vice is shown by the table to be relatively low.

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[*] "It is worthy of remark that these simple islanders, without hope of reward or fear of future punishment after death, live in such peace and brotherly love with one another, and that they recognize the right of property in the fullest sense of the word, without there being any authority among them other than the decision of their elders, according to the customs of their forefathers, which are held in the highest regard." (Earl Kolff's "Voyages of the Dogma," p. 161.)

[†] "The Rock Veddahs are divided into small clans, or families, associated for relationship, who agree, partitioning the forests among themselves for hunting-grounds, the limits of each family's possession being marked by streams, hills, rocks, or some well-known trees, and these conventional allotments are always honorably recognized and mutually preserved from violation. Each party has a head man, the most energetic senior of the tribe, but who exercises no authority except distributing at a particular season the honey captured by the members of the clan." (Tennant, ii, p. 440.)

[‡] "The Dyaks' minds are as healthy as their bodies; theft, brawling, and adultery are unknown to them." (Boyle's "Borneo," p. 335.)

"The Dyaks are manly, hospitable, honest, kindly, and humane to a degree which might well shame ourselves." (Ibid, p. 215.)

[#] "Nothing like a chief could be made out among the Fuegians of Blunder Cove, nor did they seem to require one for the peace of their society, for their behavior one to another was most affectionate, and all property seemed to be possessed in common." (Weddell's "Voyages toward the South Pole," p. 168.)

The Rev. F. H. Wines, statistician and philanthropist, who has made questions of crime and criminals the study of a lifetime, was selected by the authorities at Washington to compile the statistics bearing on delinquents in the tenth census; and after a careful study of the mass of figures returned, but few of which appear in the compendium, he makes this very remarkable statement concerning the facts collected and enumerated: "If a comparison is made between offenses against public morals and against public peace, the smallest amount of disorder and the largest of immorality, relatively, are found among the native whites, the most disorder and least immorality among the negroes; and the foreigners occupy a middle ground between the two." ("American Prisons in the Tenth Census," "Proceedings of the National Prison Association for 1888," p. 268.) When it is realized that the native whites represent the better educated portion of our population, and the negroes the more illiterate, while the foreigners are on an educational scale between the two, the significance of the statement can neither be gainsaid nor belittled.

We are, then, confronted by facts which reveal a condition of decreasing illiteracy and increasing crime, of augmenting wealth with more wide-spread destitution. While inventors and engineers have united continents by steamship lines and cables, States by telegraph and railway lines, and cities by bridges, statesmen have vainly sought to unite the interests of employers and employés, of railway managers and shippers, of producers and consumers; and every legislative measure intended to harmonize the interests of these conflicting elements has given rise to greater irritation and more complicated evils.

Since the record of material progress and mechanical construction has been one of unvarying certainty and triumph, while legislation has so often led to failure in the investigation of this educational problem, will it not be well to reject the hap-hazard devices of the legislator, and confine ourselves to the scientific methods so successfully employed by the constructing engineer and mechanical inventor? Take, for illustration, the history of Bessemer steel railway-bars. The introduction and use of these bars for our railway-tracks so cheapened the cost of transportation that it made possible the development of the far Western States and Territories, which find themselves enabled to profitably market produce thousands of miles away.

Twenty years ago, under a traffic which constituted but a
all fraction of the mileage which the same roads are perform-
, iron rails became worn down and laminated with such
the cost of track repairs was enormous, and it

was by no means uncommon for iron rails to be removed from the track worn out before they had been subjected to a single season's wear. About that time the Bessemer steel rail was introduced, and its hard, homogeneous metal offered great resistance to the wear and abrasion of the rolling wheels. But a new difficulty appeared; for, while the steel rails suffered but little from wear, they developed a provoking tendency to break without giving any previous warning, which served to increase the danger of railroad traveling. Upon the discovery of this evil, the engineers in charge neither discarded the Bessemer rails, nor did they close their eyes to its obvious defects, but, in imitation of our social concerns, they kept acurate statistics of the life and breakage of the rails, and finally discovered that, in the effort to resist the tendency to wear, they had gone so far as to make the metal brittle; hence the saving to wear was partly lost because of the failure of rails by breaking. Less carbon was put into the steel, and a softer metal was produced, which, while vastly superior to iron as against lamination and abrasion, was sufficiently soft to avoid the breaking, with its attendant dangers.

Do not the facts disclosed by our social statistics cause it to appear that, in the adjustment of our schools, we have gone too far in our aim for material advancement and development of wealth, and that we are correspondingly losing in the direction of moral growth and culture? Let us, then, imitate the prudence of the railway engineer, and, though seeking to retain the advantages which are already ours, let us not be blind to the visible defects and besetting dangers of our present system. Let us determine the composition of the training of our public schools; let us see if its parts are well proportioned and the compound skillfully wrought, and a thorough analysis may prove, as with the Bessemer steel rail, that, by a judicious change in the nature or proportion of the ingredients, our rapid increase of wealth may suffer a trifling diminution, but the moral balance of education will be restored, and material, political, and moral progress will move forward together.

In his presidential address to the Royal Geographical Society, President Strachey, assuming that the last barrier excluding us from unknown regions would soon be broken through, named the establishment of the supremacy of modern civilization and progress over Africa as the next geographical problem. That continent presents wholly different conditions from any other land that has been brought under civilization, and will call for different methods of management. It can not be directly colonized, as were North America and Australia, or administered as India is; and amalgamation between European settlers and the indigenous races is wholly out of the question. The operation will necessarily be a long and, in some respects, a painful one.

THE TAOUIST RELIGION.

By WARREN G. BENTON.

IN an attempt to unravel the mysteries of the religions of the Chinese, one is confused at the outset by the almost obliterated lines between the three leading forms of religion existing side by side. The process of amalgamation has gone on for so many centuries that one is liable to be misled in an effort to analyze the different creeds. The fact is that Buddhism, Taouism, and Confucianism have existed in the same minds until a belief in the distinctive phases of each has become quite common. And even those who nominally accept the Christian religion, either Catholic or Protestant, really add the new to the old faiths, and believe more or less in the four religions. It is thus true that in one mind may be found a belief in four primarily distinct and separate religions—each having added its quota toward a result whose aggregate beliefs are derived from wholly dissimilar sources; and the result is, as might be looked for, a unique specimen of religionist.

In this paper I shall endeavor to indicate the particular features of Taouism.

This system of religion is pronounced indigenous to China. Its founder was one Laou-tse, who is supposed to have lived contemporary with Confucius, and to have been some years older than that celebrated philosopher. The word *Taou* signifies *reason*, and therefore a *Taouist* is a *rationalist*, in name at least; but, in *fact*, the Taouists are the most *irrational* of all the religionists of the East.

The tendency in rationalism is toward the utter destruction of belief in the existence of unseen spirits of evil. Enlightened reason dethrones devils; but Laou-tse created devils innumerable, and the chief concern of the Taouist sect has always been to manipulate these emissaries of evil. Modern rationalists deny the existence of devils, and relegate them to the category of myths and to personified ideas.

Not so the rationalist of the Orient. He finds his greatest pleasure in contemplating the very atmosphere he breathes as filled with spirits constantly seeking his injury; and to outwit his satanic majesty is the chief end of life.

The sect is founded on the monarchic plan. The chief high priest corresponds to the Pope in the Catholic religion, and all
ty is vested in him. His decrees constitute the laws of the
wer to perform miracles must come from him to
has the power to exorcise devils and to heal

the sick and avert calamities, and this power he delegates to such of the priesthood as command his favor. Such delegated power, however, is held on sufferance, and not in fee-simple. It is not only necessary that a priest gain favor with his royal highness to get this power, but he must retain said favor in order to hold the power. This has created a vast army of priests, who are the willing tools of the high priest; and he is thus enabled to wield the most absolute and despotic sway over the minds of the people.

The system has the most elaborated code of demonology, and it is likewise patterned after the political constitution of the empire. The head devil lives in the sea, and has been honored by the Chinese people by being adopted as their national emblem. The dragon flag, which floats from every staff, from the dome of the royal palace at Pekin to the mast-head of the humblest Chinese boat, testifies to the high esteem in which the chief devil of Laou-tse's followers is held. Then the multitude of lesser devils is so great that no man can number them; and these are on the track of every man, woman, and child, seeking in all methods their injury. To watch the movements of this devil host, and to frustrate their designs, is the province of the Taouist priests.

Here we have a decidedly interesting state of things. The very earth teeming with malicious demons! Man everywhere exposed to their attacks, and but one avenue of escape, viz., through the interventions of the priests! Is it a matter of surprise, therefore, that this priesthood wields such absolute power over the minds of the people? They live on the fat of the land. They are consulted on all occasions, and their instructions are obeyed to the letter by their deluded followers. It is not to be wondered at that these priests look with disfavor upon the advent of Europeans; that they fill the minds of the people with such antipathy to all change from the established order. They are wise enough to forecast their own overthrow with the advent of a deeper intelligence.

The priests are celibates, perhaps with the thought that, if they were to prove unequal to the task of managing a wife, their prestige in devil manipulation might suffer. They keep aloof from the common life around them and live in mountains and unfrequented and isolated places, that they may the better impress their own superiority over their fellows.

The priests are called upon by the people when it is discovered that a home or village is infested by a devil. Devils have the power to materialize themselves into a piece of waste paper or dirt in order to get into the houses unobserved. These devils are not credited with a high order of intelligence. Chinese architecture is governed by this conception. The doors or main entrances are put in unexpected angles and niches in the walls, with the idea that they will fool the devils. They cut up the roof-lines on dwellings into fantastic shapes for the purpose of preventing devils using them for promenade purposes; and, as a matter of fact, these imps have hard work to get into the houses. But, when they once get in, no power is able to get them out except the priests.

The white horse is a common form in which devils infest a community. They appear in the form of a white horse walking upon the city walls, and over graveyards, and even stepping from one roof to another. He is thus seen by some truthful witness, and the evil omen soon gains currency.

The intervention of the nearest priest is sought, who takes a survey of the situation, and discovers the number of devils, if more than one, and calculates on the necessary steps to capture it or them.

The financial ability of the community has much to do in determining the means of safety. If the locality is wealthy, or has a few wealthy men in it, the priest generally makes out a strong case. He may require to call in other priests in consultation. All this time the people dwell in morbid fear, pending deliverance. At length the priests announce their ultimatum. It will require a fee of one hundred taels (about one hundred and thirty-three dollars, American money) to procure safety. The money is raised by public subscription and paid over to the priest in charge. Then the capture of the devils is the next step.

A bottle or jar is secured for each devil, and the priests secure a bait in the shape of imitation gold and silver tinted paper (called Joss paper). This paper is imitation money, and when it is reduced to spirit by being burned, the devils do not know it from genuine money—here again showing their low mentality —and they enter the bottle in which the Joss paper has been burned. When they are thus entrapped, the bottle is sealed and carried away by the priest. Then the people feel grateful to their deliverer, and the priest has again impressed his importance to the welfare of the community and at the same time replenished his bank account. The "Tsung li Yamen," or office of the head priest of this sect, is a curiosity. It has large halls and rooms filled with dust-covered and sealed jars, in every one of which is confined a devil, captured in the above unique plan. And were each and every jar filled with silver, I question if it would equal the sums paid for the capture of these imprisoned devils.

This demonology enters into every phase of Chinese life. The priest is the only medium between the people and their invisible foe. Not a voyage is undertaken until the devils are baited by burning bogus paper money. Not a wedding, but the priest is called in to decipher the omens for good or ill luck. And when a man is sick, he is possessed of devils. Chills are the most common form of possession. What makes a man shake if he is not in the power of a devil? So the people believe, and a priest is called instead of a doctor, and prayers take the place of pills. Epileptic fits or convulsions are the devil in a malignant form; and if a man is taken thus in a crowded building, that building is rapidly deserted.

A good doctor could go among the Chinese and, by curing the sick, attending his physic by incantations, enthrone himself as a deity in the belief of that deluded people. When a man is dying, no money would induce a Chinaman to remain near him. I first met this fact on a Pacific steamer bound from San Francisco to Hong-Kong. I was walking on the deck with the ship's surgeon, when a stream of Chinamen came rushing on deck from the lower decks like a colony of ants when disturbed. I asked what had caused such a stampede. The doctor replied that a Chinaman was dying. He hurried below, and found a man gasping his last breath, with consumption. I discovered later, when pursuing my studies of Chinese religions, the secret of this strange stampede. The devil was after the soul of that poor consumptive, and the rest were not going to take any chances by remaining near him in the final struggle.

Not every wise-looking magpie or crow, which alights upon the bough of a tree to rest, is the innocent creature it appears to be; but a devil in disguise spying out the lay of the land. Nor do the frightened people seek relief by killing the bird of evil omen, but they call a priest to look into the matter. He generally advises that the tree be cut down in the night and removed.

Thus, when the devil, *alias* a magpie, returns to his perch, he is fooled, and thus thrown off the track.

The ceremonies so often observed on occasions of death all have their origin in the demonology of the Taouists. Paper suits, paper palaces, paper pipes and money are burned when a man dies, to provide the soul of the dead with means of bribing its way through the devil's kingdom to its rest, and the suits burned are often patterned after high officials' gowns, in order to impress more favorably the spirits encountered on the mysterious journey.

Taouist priests are called to consult the soul of the departed to ascertain its wishes. They discover the locality for burial, and indicate all details of this last service to the dead.

The Shanghai Railroad met its doom from this source. The priests informed the people that the rumbling noise of the cars and the steam-engine were distasteful to the dead who filled the numerous mounds along its course. To appease the wrath of the dead, Chinese capitalists bought the road with its equipments, and tore up the tracks and stored the entire plant under sheds at Shanghai. Thus it is seen that this religion stands in the way of all innovations in that old country, and the first thing necessary in order to introduce railroads into China is to dethrone the priests and infuse a little common sense into the people.

Since this last paragraph was written, this point has had a characteristic demonstration. Through the influence of Li Hung Chang, the most intelligent and progressive Chinaman, and one or two other high officials, the emperor was prevailed upon to grant the construction of a railroad from Hankow to Pekin. Not many days had elapsed after the permit was given until the Temple of Heaven at Pekin was burned, and floods came in the Yellow and Yang-tse River Valleys, which were interpreted to have been indications of the disapproval of the proposed innovation on the part of spirits or the Taouist devil; and the press dispatches announce that the emperor has taken the timely warning and revoked his sanction of the proposed railroad. Any one having to make the journey between the two objective points of the proposed road will save time by starting on foot, or going around *via* Shanghai by water. Otherwise he is liable to have a long time to wait for the completion of the road.

During the prevalence of the great famine in northwestern China in 1874–'78 there was an unusual flood in the valley of the Yang-tse-Kiang. The priests endeavored to solve the mystery of this uneven distribution of rain. The censure fell upon the royal household at Pekin. It is the duty of the emperor to enter the Temple of Heaven twice a year and invoke the blessings of Heaven upon the people. He always asks for rain among other things, and the impression obtained that the emperor had hurriedly asked for rain, but had not taken the pains to state where he wanted it. The result was that floods came in some places, while famine from drought came in other parts of the empire. This feeling was producing a general spirit of revolt, when in 1878 the rains came to the rescue in the drought-smitten provinces.

At this time I had a conversation with a merchant at Shanghai on the subject. He exhibited an independence of thought which was exceptional. But it showed a tendency toward the inevitable break from the tyrannical rule of ignorance and superstition which must eventually come to awaken an age of reason. And when it comes, the Taouist high priest must fold his tent and silently march away.

The merchant said, "Chinaman, he all time chin, chin" (meaning that they resort to prayers and other priestly methods in time of calamity), "while Melican man, he build more stout walls to keep water back."

[illegible] one man concluded that substantial sea-walls and dikes were more availing in times of flood than prayers as a protection from encroaching waters from overflowing rivers.

But the dominance of ignorance and the quackery of priests will hold China in slavery to an unreasoning fear and irrational faith for generations yet unborn. Yet the seeds of a better intelligence are being planted in this dark corner of the earth. The people observe that Europeans give no heed to imaginary devils, and still they prosper without the intervention of priests; and thus will eventually dawn upon them how grievously their forefathers have been hoodwinked, cheated, and robbed by the reign of demonology, created and perpetuated for their own gain by the army of Taouist priests.

LETTERS ON THE LAND QUESTION.

By HERBERT SPENCER, FREDERICK GREENWOOD, Professor HUXLEY, Sir LOUIS MALLET, and JOHN LAIDLER.

THE following letters, reprinted from the London "Times" of recent dates (from November 7 to 15, 1889), are of great interest on account of the light they throw upon some of the more important aspects of the question of land nationalization, and on the problems of socialism in general.—Editor.]

MR. SPENCER'S FIRST LETTER.

To the Editor of "The Times":

Sir: During the interview between Mr. Morley and some of his constituents, reported in your issue of the 5th inst., I was referred to as having set forth certain opinions respecting land-ownership.* Fearing that, if I remain silent, many will suppose I

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* *Extract from the Morley Interview.*

Mr. Laidler said their method of dealing with the land would be that the present owners should hold it for their time, and that it should revert back to the State. They remembered that Mr. Herbert Spencer had said that the land had been taken by force and by fraud. That gentleman had also said that to right one wrong it takes another.

Mr. Morley.—Has Mr. Spencer said this?

Mr. Laidler.—Yes; we all know.

Mr. Morley.—You are aware that he has recalled some of the things he has laid down?

Mr. Laidler.—If he has stated truth and recalled it, the truth will prevail.

Mr. Morley.—Do you include houses?

Mr. Laidler.—We include land, not houses. In houses there is labor, but in land there is not.

Mr. Morley.—Not?

Mr. Laidler.—There may be labor exerted in land, but as far as the labor is in the land we believe it ought to belong to the laborer. As the land has been obtained by the method I have named—by force and fraud, as Spencer says—we contend that the land ought to be taken back by the community and handed over to the municipalities and county councils to be used in such democratic manner as the people may elect those bodies for.

Mr. Morley.—I can not think that what is commonly called nationalization of the land have said things which I have not said, I find it needful to say something in explanation.

Already within these few years I have twice pointed out that these opinions (made to appear by those who have circulated them widely different from what they really are, by the omission of accompanying opinions) were set forth in my first work, published forty years ago; and that, for the last twelve or fifteen years, I have refrained from issuing new editions of that work and have interdicted translations, because, though I still adhere to its general principles, I dissent from some of the deductions.

The work referred to—"Social Statics"—was intended to be a system of political ethics—absolute political ethics, or that which ought to be, as distinguished from relative political ethics, or that which is at present the nearest practicable approach to it. The conclusion reached concerning land-ownership was reached while seeking a valid basis for the right of property: the basis assigned by Locke appearing to me invalid. It was argued that a satisfactory ethical warrant for private ownership could arise only by contract between the community, as original owner of the inhabited area, and individual members, who became tenants, agreeing to pay certain portions of the produce, or its equivalent in money, in consideration of recognized claims to the rest. And in the course of the argument it was pointed out that such a view of land-ownership is congruous with existing legal theory and practice; since in law every land-owner is held to be a tenant of the Crown—that is, of the community, and since, in practice, the supreme right of the community is asserted by every Act of Parliament which, with a view to public advantage, directly or by proxy takes possession of land after making due compensation.

All this was said in the belief that the questions raised were not likely to come to the front in our time or for many generations; but, assuming that they would some time come to the front, it was said that, supposing the community should assert overtly the supreme right which is now tacitly asserted, the business of compensation of land-owners would be a complicated one:

> One that perhaps can not be settled in a strictly equitable manner. . . . Most of our present land-owners are men who have, either mediately or immediately, either by their own acts or by the acts of their ancestors, given for their estates equivalents of honestly earned wealth, believing that they were investing their savings in a legitimate manner. To justly estimate and liquidate the claims of such is one of the most intricate problems society will one day have to solve.

To make the position I then took quite clear, it is needful to add that, as shown in a succeeding chapter, the insistence on this

is anything but what it was called the other day—either robbery or folly. I have really no more to say on that subject.

doctrine, in virtue of which "the right of property obtains a legitimate foundation," had for one of its motives the exclusion of Socialism and Communism, to which I was then as profoundly averse as I am now.

Investigations made during recent years into the various forms of social organization, while writing the "Principles of Sociology," have in part confirmed and in part changed the views published in 1850. Perhaps I may be allowed space for quoting from "Political Institutions" a paragraph showing the revised conclusions arrived at:

> At first sight it seems fairly inferable that the absolute ownership of land by private persons must be the ultimate state which industrialism brings about. But though industrialism has thus far tended to individualize possession of land while individualizing all other possession, it may be doubted whether the final stage is at present reached. Ownership established by force does not stand on the same footing as ownership established by contract; and though multiplied sales and purchases, treating the two ownerships in the same way, have tacitly assimilated them, the assimilation may eventually be denied. The analogy furnished by assumed rights of possession over human beings helps us to recognize this possibility. For, while prisoners of war, taken by force and held as property in a vague way (being at first much on a footing with other members of a household), were reduced more definitely to the form of property when the buying and selling of slaves became general; and, while it might centuries ago have been thence inferred that the ownership of man by man was an ownership in course of being permanently established, yet we see that a later stage of civilization, reversing this process, has destroyed ownership of man by man. Similarly, at a stage still more advanced, it may be that private ownership of land will disappear. As that primitive freedom of the individual which existed before war established coercive institutions and personal slavery comes to be re-established as militancy declines, so it seems possible that the primitive ownership of land by the community, which, with the development of coercive institutions, lapsed in large measure or wholly into private ownership, will be revived as industrialism further develops. The *régime* of contract, at present so far extended that the right of property in movables is recognized only as having arisen by exchange of services or products under agreements, or by gift from those who had acquired it under such agreements, may be further extended so far that the products of the soil will be recognized as property only by virtue of agreements between individuals as tenants and the community as land-owner. Even now, among ourselves, private ownership of land is not absolute. In legal theory land-owners are directly or indirectly tenants of the Crown (which in our day is equivalent to the State, or, in other words, the community); and the community from time to time resumes possession after making due compensation. Perhaps the right of the community to the land, thus tacitly asserted, will in time to come be overtly asserted and acted upon after making full allowance for the accumulated value artificially given. . . . There is reason to suspect that, while private possession of things produced by labor will grow even more definite and sacred than at present, the inhabited area, which can not be produced by labor, will eventually be distinguished as something which may not be privately possessed. As the individual, primitively owner of himself, partially or wholly loses ownership of himself during the militant *régime*, but gradually resumes it as the industrial *régime* develops, so possibly the communal

proprietorship of land, partially or wholly merged in the ownership of dominant men during evolution of the militant type, will be resumed as the industrial type becomes fully evolved (pp. 643–646).

The use of the words "possible," "possibly," and "perhaps" in the above extracts shows that I have no positive opinion as to what may hereafter take place. The reason for this state of hesitancy is that I can not see my way toward reconciliation of the ethical requirements with the politico-economical requirements. On the one hand, a condition of things under which the owner of, say, the Scilly Isles might make tenancy of his land conditional upon professing a certain creed or adopting prescribed habits of life, giving notice to quit to any who did not submit, is ethically indefensible. On the other hand, "nationalization of the land," effected after compensation for the artificial value given by cultivation, amounting to the greater part of its value, would entail, in the shape of interest on the required purchase-money, as great a sum as is now paid in rent, and indeed a greater, considering the respective rates of interest on landed property and other property. Add to which, there is no reason to think that the substituted form of administration would be better than the existing form of administration. The belief that land would be better managed by public officials than it is by private owners is a very wild belief.

What the remote future may bring forth there is no saying; but with a humanity anything like that we now know, the implied reorganization would be disastrous.

I am, etc., HERBERT SPENCER.

ATHENÆUM CLUB, *November 6th.*

MR. GREENWOOD'S LETTER.

To the Editor of "The Times":

SIR: Mr. Herbert Spencer's letter in "The Times" of to-day carries with it a heavy lesson to political philosophers. They are taught to remember that this is an age of popular education, as well as of social unrest; that their books are read not only by students like themselves, who often find their chief interest in a display of intellectual subtlety or athleticism, but by thousands of men who are ever on the alert for warranted theories of social reform that will better their condition. And if such theories should happen to be ill-considered before publication, or unaccompanied by a strong and clear recital of whatever reasons are fatal to their application in this work-a-day world, the mischief they may do is enormous. How clearly Mr. Spencer himself must see this now! And how sorry he must be for having so terribly misled, not Mr. Laidler and the Labor party of Newcastle alone—that is not imaginable—but many other poor men also who habitually hang on the authority of great men like himself.

It was when Mr. Morley was so delicately heckled at Newcastle that a member of the Labor party deputation asked him what he thought about the nationalization of the land. Mr. Morley demurred. Mr. Laidler said the Labor party had its own plan. "They remembered that Mr. Herbert Spencer had said that the land had been taken by force and fraud; that gentleman had also said that to right one wrong it takes another." "Why," replies Mr. Morley, "has he said this?" "We all know he has," rejoins Mr. Laidler. "But you are aware that he has recalled some of the things he has laid down?" "Yes," rejoins Mr. Laidler; "but if he has stated truth and recalled it the truth will prevail." There we are. This little bit of conversation is precious beyond many pages of "absolute political ethics," judged by the standard of usefulness; and it will be useful to nobody so much as to writers like Mr. Herbert Spencer.

For what has he to say to it all? He says that the opinions quoted by Mr. Laidler were set forth forty years ago in a work "intended to be a system of absolute political ethics; or that which ought to be, as distinguished from relative political ethics, or that which is at present the nearest practical approach to it." These opinions were accompanied by others which forbid the interpretation sometimes put upon them. But yet, on reflection, they satisfied Mr. Spencer so little, he thought them so little guarded or corrected by those other opinions of his, that for the last fifteen years he has not allowed the book that contained them to appear in any language. "Though I still adhere to its general principles, I dissent from some of the deductions"—those, perhaps, which Mr. Laidler regards as truth once uttered and never to be recalled. Besides, what Mr. Spencer said on this subject "was said in the belief that the questions raised were not likely to come to the front in our time or for many generations"; and it did include the statement that, if the community took the land, the necessary business of compensation would be a complicated one. "To justly estimate and liquidate the claims" of our present land-owners "is one of the most intricate problems society one day will have to solve." Since "Social Statics" was published, however, Mr. Spencer has come to revised conclusions; and these he now sets forth in "The Times." Permit me to quote a few sentences from this statement:

> Though industrialism has thus far tended to individualize possession of land, while individualizing all other possessions, it may be doubted whether the final stage is at present reached. Ownership established by force does not stand on the same footing as ownership established by contract; and though multiplied sales and purchases treating the two ownerships in the same way have tacitly assimi-

> lated them, the assimilation may eventually be denied. . . . There is reason to suspect that, while private possession of things produced by labor will grow even more definite and sacred than at present, the inhabited area, which can not be produced by labor, will eventually be distinguished as something which may not be privately possessed. . . . Possibly the communal proprietorship of land, partially or wholly merged in the ownership of dominant men during evolution of the militant type, will be resumed as the industrial type becomes fully evolved.

After quoting these and similar passages from his revised opinions, Mr. Spencer makes the following observations: "The use of the words 'possible,' 'possibly,' and 'perhaps,' in the above extracts shows that I have no positive opinion as to what may hereafter take place." But of this Mr. Spencer feels sure: Nationalize the land on righteous principles of compensation, and the interest on the purchase-money would exceed the sum now paid in rent. Moreover, it is a "wild belief" that the land would be better managed—i. e., more profitably managed—by public officials than by private owners. "With a humanity anything like that we now know, the implied reorganization would be disastrous."

Well, we have only to do with the humanity that we now know; and being what it is, surely Mr. Spencer should have taken pains from the beginning to consider its manifold weaknesses and temptations. Yet still he repeats that the individual ownership of land was established by force, the assertion that Mr. Laidler and the Labor party of Newcastle stand upon. While, as for his perhapses and possiblies, they are in fact expressions of doubt as to whether the community will or will not resume ownership of the land, but they are not necessarily to be taken in that sense, and any Mr. Laidler might be forgiven if he saw in them a suggestion of the right thing to do, or a prophecy the fulfillment of which it would not be wrong to precipitate. All the more reasonably might he think so when he sees that in these same revised conclusions Mr. Spencer likens the acquisition of property in land by individuals to the old-time "ownership of man by man." "The ownership of land was established by force"; it originated in robbery; at the root it is robbery still. That is the point for Mr. Laidler; and, writing for humanity as we know it, and as the next generation is likely to know it, it is a pity that Mr. Spencer did not guard at once and in the strongest way against the probable use that humanity, as we know it, would make of the assertion. The possible resumption of the land by some totally different generation of humanity, one that we know not of, should not have been committed to print as the righting of a wrong, without the clearest warning that, till that generation comes, land nationalization must be an exceeding great folly, amounting to absolute disaster. For the good of humanity, that was always the most important point to insist upon. It is to be feared that some thousands of Laidlers will not think so much of it now. So much does it become political philosophers to be careful. Some medicines are also poisons; such medicines should never be issued over the counter to any and every purchaser without a warning label; and this I hope I may say without seeming disrespect for Mr. Herbert Spencer.

Your obedient servant,

FREDERICK GREENWOOD.

November 7th.

PROF. HUXLEY'S LETTER.

To the Editor of "The Times":

SIR: I have read with very great interest the "heckling" of Mr. Morley, the letters of Mr. Spencer and of Mr. Greenwood, and your editorial comments on this triangular duel. But, if I may speak in the name of that not inconsiderable number of persons to whom absolute ethics and *a priori* politics are alike stumbling-blocks, permit me, borrowing a phrase which a learned judge has immortalized, to say that "You have not helped us much."

Let me explain the nature of the further help we require by putting a case which is not altogether imaginary:

A score of years ago A. B. bought a piece of land; he paid the price asked by the vender, and all the conditions required by the law were fulfilled in the transference of ownership. The transaction was as much a free contract as if A. B. had gone to market and bought a cabbage. At the time that A. B. handed over his money he believed that the State was a copartner in the contract, in so far that it undertook to maintain his rights of ownership against everything and everybody who should attempt to invade them, except an act of the Legislature, or the orders of the commanding officer in war-time, or a police officer legally authorized. A. B. has gone on paying his taxes to the State all these years, in full conviction that the State contracted, among other things, to afford him the protection thus defined.

A. B.'s lawyers assured him that the title to the land was perfectly good. This means that, for several centuries at least, neither force nor fraud has intervened, but that the land has passed from owner to owner by free contract. At the same time, A. B., who is somewhat pedantic in the matter of historical accuracy, admits that, for anything he knows to the contrary, in the reign of King John his bit of land may have belonged to Cedric the Saxon; and that possibly the son-in-law of that worthy thane, after the quarrel with Rowena, related by an historian of later date than Scott, may have taken forcible possession of it, and, in virtue of his favor at Court, kept it for himself and his descendants.

Now, my friends and myself, having no better guides than common morality and common sense, are of opinion that, supposing Ivanhoe to have behaved in this scandalous fashion, the fact makes not the smallest difference in justice or in equity to the title of A. B.; and that, if it did, the State, which has contracted to defend A. B.'s title without the least reference to such antiquarian contingencies, would commit a gross fraud if it broke its contract on any such flimsy pretenses.

The right to compensation is not in question; what we deny is the right to disturb A. B. on such a ground.

It would appear, however, that there is some better guidance than that of common morality and common sense; "absolute political ethics" is an infallible indicator of what we ought to do—whether the action indicated is possible or impossible.

Now, what we want is this very light as to what we ought to do in such a concrete case as that I have mentioned. The dictum that "ownership established by force does not stand on the same footing as ownership established by contract," I must repeat, "does not help us." Construed strictly, it is a mere truism; construed broadly, it may cover Mr. Laidler's view.

What we want to know is this: According to "absolute political ethics," has A. B. a moral as well as a legal right to his land or not?

If he has not, how does "absolute political ethics" deduce his title to compensation? And, if he has, how does "absolute political ethics" deduce the State's right to disturb him?

No question is raised here as to the right of the State to deal with A. B.'s land or anything else he possesses on grounds of public utility or necessity; nor do we want to know what may be done by the wisdom or the folly of future generations. "Absolute political ethics" should be independent of time and space; and it ought to be able to tell us whether, *in foro conscientiæ*, A. B., if he continue to hold his land under the circumstances supposed, is an honest man or a receiver of stolen goods.

I intervene in this discussion most unwillingly, but I have long been of opinion that the great political evil of our time is the attempt to sanction popular acts of injustice by antiquarian and speculative arguments.

My friend Mr. Spencer is, I am sure, the last person willingly to abet this tendency. But I am afraid that, in spite of all Mr. Spencer's disclaimers, the next time Mr. Morley visits his constituents his pertinacious "heckler" will insist that, after all, the younger and the older philosopher are not disagreed in principle; and that the difference of "footing" between ownership primarily based on force and other ownership can not be cured by efflux of time, and justifies the State now, or at any future period, in dealing differently with the two.

In Ireland confiscation is justified by the appeal to wrongs inflicted a century ago; in England the theorems of "absolute political ethics" are in danger of being employed to make this generation of land-owners responsible for the misdeeds of William the Conqueror and his followers.

I am, sir, your obedient servant,

T. H. HUXLEY.

November 11th.

SIR L. MALLET'S LETTER.

To the Editor of "The Times":

SIR: Mr. Frederick Greenwood's letter, and the leading article in "The Times" of to-day, on Mr. Herbert Spencer's recent letter upon this subject, leave little more to be said on several aspects of the question, but there are one or two points upon which I should be glad of an opportunity of adding a few remarks.

The passage in the "Political Institutions" quoted by Mr. Herbert Spencer has been long familiar to the students of his writings, and to some of them, who, like myself, are among his sincere admirers, has always been a subject of surprise and regret.

The whole extract should be read, but to save your space I confine myself to the concluding sentences, which are enough for my purpose:

> There is reason to suspect that while private possession of things produced by labor will grow even more definite and sacred than at present, the inhabited area, which can not be produced by labor, will eventually be distinguished as something which may not be privately possessed. As the individual, primitively owner of himself, partially or wholly loses ownership of himself during the militant *régime*, but gradually resumes it as the industrial *régime* develops; so, possibly, the communal proprietorship of land, partially or wholly merged in the ownership of dominant men during evolution of the militant type, will be resumed as the industrial type becomes fully evolved.

The analogy here suggested between the ownership of man by other men, or slavery, and the private ownership of land, with the inference drawn from it, that as the first has been abolished in civilized countries the second may possibly share its fate, has always appeared to me essentially fallacious.

The principle of private property, so far as the term is applicable to human beings, has not in their case been abolished—on the contrary, it has been signally vindicated.

The destruction of slavery asserted the right of every man to property in himself, while prohibiting the ownership of man by other men, both individually and collectively. It was the restitution of a right of property from a wrongful to a rightful owner. In order to render Mr. Spencer's analogy applicable, it seems to me that the right of ownership in one man by another, instead of being abolished altogether, should have been transferred, as it is proposed to do in the case of land, from the individual to the State.

But, however this may be, it seems clear that the principle which excludes the ownership of one man by another, rests upon the same grounds as that which includes private property in land—viz., that the general interests of society are best promoted by personal freedom.

There seems to be sufficient evidence that compulsory labor is less productive than free labor; and if this is so we may conclude, even setting aside all considerations of humanity or morality, that the interests of society are better promoted by free labor or property in one's self, than by slavery or property in others.

This is usually admitted, but it is necessary to insist upon what is always forgotten by those who declaim against private property in land—that this last institution also is an essential condition of personal freedom, as by no other means short of coercion can a due relation be maintained between demand and supply.

Whoever holds the land holds that which, being limited in extent (the only assumption on which the question arises), imposes on its possessor the function and duty, which he is bound in the interest of society, no less than his own, to perform, of restricting an undue pressure on the soil, whether for agricultural or urban purposes, whether for food or shelter, by the increasing wants of the population.

If the family is the economic unit, this object may be effected by the exercise of the personal responsibility and authority of its head in regulating supply, and by a gradual augmentation of price and rent in restraining demand. When the limits of production or supply are reached, any additional population must migrate or be supported, if possible, by charity.

But whenever the economic unit is extended so as to include a whole community, this personal responsibility, and with it personal liberty, disappears. In a small district (a village or canton) where the conditions approximate to family or patriarchal life the evil is mitigated; but in a large and complex society, to vest the property of the soil in the State—i. e., in a central Government, removed, as it must be, from all personal contact with individuals—is to throw upon it the paramount obligation of either regulating the increase of population or of providing food and shelter for increasing numbers by progressive inroads upon the accumulated capital of the country—in short, upon the net product, which is the only source of a progressive civilization. The first of these alternatives can not be better described than in the words of Bastiat:

> Ce serait créer le plus faillible, le plus universel, le plus immédiat, le plus inquisitorial, le plus insupportable, et disons, fort heureusement, le plus impossible, de tous les despotismes que jamais cervelle de pacha ou de mufti ait pu concevoir.

The second course could only lead to the gradual pauperization and ultimate bankruptcy of any country which had the folly to embark in it. Such an experiment would be only comparable to that of a vast joint-stock company in which all comers were entitled to shares without paying for them.

The distinction drawn by Mr. Herbert Spencer, in common with the late Mr. Mill, between private property in land and private property in things produced by labor is one which I believe to have no economic justification whatever. It ignores the fundamental principle, on which the institution of private property is grounded—viz., that a due relation between demand and supply can be maintained in no other way consistently with personal freedom.

From this point of view the fact that the supply of land is practically limited, and that it is, therefore, a natural monopoly, renders it not less but more necessary that it should be allowed to be the subject of private appropriation.

Sir Henry Maine has summed up the whole question in a few words, which can not be too often repeated:

> There are two sets of motives, and two only, by which the great bulk of the materials of human subsistence and comfort have hitherto been produced and reproduced. One has led to the cultivation of the Northern States of the American Union from the Atlantic to the Pacific; the other had a considerable share in bringing about the agricultural and industrial progress of the Southern States, and in old days it produced the wonderful prosperity of Peru under the Incas. One system is economical competition, the other consists in the daily task, perhaps fairly and kindly allotted, but enforced by the prison or the scourge. So far as we have any experience to teach us, we are driven to the conclusion that every society of men must adopt one system or the other, or it will pass through penury to starvation. ("Popular Government.")

I have the honor to be, sir, your obedient servant,

Louis Mallet.

13 Royal-Crescent, Bath, *November 9th.*

MR. SPENCER'S SECOND LETTER.

To the Editor of "The Times":

Sir: As Prof. Huxley admits that his friend A. B.'s title to his plot of land is qualified by the right of the State to dispossess him if it sees well—as, by implication, he admits that all land-owners hold their land subject to the supreme ownership of the State, that is, the community—as he contends that any force or fraud by which land was taken in early days does not affect the titles of existing owners, and *a fortiori* does not affect the superior title of the community—and as, consequently, he admits that the community, as supreme owner with a still valid title, may resume possession if it thinks well, he seems to me to leave the question standing very much where it stood; and since he, as I suppose, agrees with me that any such resumption, should a misjudgment lead to it, ought to be accompanied by due compensation for all artificial value given to land, I do not see in what respect we disagree on the land question. I pass, therefore, to his comments on absolute political ethics.

> "Your treatment is quite at variance with physiological principles" would probably be the criticism passed by a modern practitioner on the doings of a Sangrado, if we suppose one to have survived. "Oh, bother your physiological principles" might be the reply. "I have got to cure this disease, and my experience tells me that bleeding and frequent draughts of hot water are needed." "Well," would be the rejoinder, "if you do not kill your patient, you will at any rate greatly retard his recovery, as you would probably be aware had you read Prof. Huxley's 'Lessons on Elementary Physiology,' and the more elaborate books on the subject which medical students have to master."

This imaginary conversation will sufficiently suggest that, before there can be rational treatment of a disordered state of the bodily functions, there must be a conception of what constitutes their ordered state: knowing what is abnormal implies knowing what is normal. That Prof. Huxley recognizes this truth is, I suppose, proved by the inclusion of physiology in that course of medical education which he advocates. If he says that abandonment of the Sangrado treatment was due, not to the teachings of physiology, but to knowledge empirically gained, then I reply that if he expands this statement so as to cover all improvements in medical treatment he suicidally rejects the teaching of physiological principles as useless.

Without insisting upon that analogy between a society and an organism which results from the interdependence of parts performing different functions—though I believe he recognizes this —I think he will admit that conception of a social state as disordered implies conception of an ordered social state. We may fairly assume that, in these modern days at least, all legislation aims at a better; and the conception of a better is not possible without conception of a best. If there is rejoicing because certain diseases have been diminished by precautions enforced, the implied ideal is a state in which these diseases have been extinguished. If particular measures are applauded because they have decreased criminality, the implication is that the absence of all crime is a *desideratum*. Hence, however much a politician may pooh-pooh social ideals, he can not take steps toward bettering the social state without tacitly entertaining them. And though he may regard absolute political ethics as an airy vision, he makes bit by bit reference to it in everything he does. I simply differ from him in contending for a consistent and avowed reference, instead of an inconsistent and unacknowledged reference.

Even without any such strain on the imagination as may be required to conceive a community consisting entirely of honest and honorable men—even without asking whether there is not a set of definite limits to individual actions which such men would severally insist upon and respect—even without asserting that these limits must, in the nature of things, result when men have severally to carry on their lives in proximity with one another, I should have thought it sufficiently clear that our system of justice, by interdicting murder, assault, theft, libel, etc., recognizes the existence of such limits and the necessity for maintaining them; and I should have thought it manifest enough that there must exist an elaborate system of limits or restraints on conduct, by conformity to which citizens may co-operate without dissension. Such a system, deduced as it may be from the primary conditions to be fulfilled, is what I mean by absolute political ethics. The complaint of Prof. Huxley that absolute political ethics does not show us what to do in each concrete case seems to be much like the complaint of a medical practitioner who should speak slightingly of physiological generalizations because they did not tell him the right dressing for a wound or how best to deal with varicose veins. I can not here explain further, but any one who does not understand me may find the matter discussed at length in a chapter on "Absolute and Relative Ethics" contained in the "Data of Ethics."

It appears to me somewhat anomalous that Prof. Huxley, who is not simply a biologist but is familiar with science at large, and who must recognize the reign of law on every hand, should tacitly assume that there exists one group of lawless phenomena—social phenomena. For if they are not lawless—if there are any natural laws traceable throughout them, then our aim should be to ascertain these and conform to them, well knowing that non-conformity will inevitably bring penalties. Not taking this view, however, it would seem as though Prof. Huxley agrees with the mass of "practical" politicians, who think that every legislative measure is to be decided by estimation of probabilities unguided by *a priori* conclusions. Well, had they habitually succeeded, one might not wonder that they should habitually ridicule abstract principles; but the astounding accumulation of failures might have been expected to cause less confidence in empirical methods. Of the 18,110 public acts passed between 20 Henry III and the end of 1872, Mr. Janson, Vice-President of the Law Society, estimates that four fifths have been wholly or partially repealed, and that in the years 1870–'72 there were repealed 3,532 acts, of which 2,759 were totally repealed. Further, I myself found, on examining the books for 1881–'83, that in those years there had been repealed 650 acts belonging to the present reign, besides many of preceding reigns. Remembering that acts which are repealed have been doing mischief, which means loss, trouble, pain to great numbers—remembering, thus, the enormous amount of suffering which this helter-skelter legislation has inflicted for generations and for centuries, I think it would be not amiss to ask whether better guidance may not be had, even though it should come from absolute political ethics.

I regret that neither space nor health will permit me to discuss any of the questions raised by Sir Louis Mallet. And here, indeed, I find myself compelled to desist altogether. In so far as I am concerned, the controversy must end with this letter.

I am, etc., **HERBERT SPENCER.**

ATHENÆUM CLUB, *November 13th.*

MR. LAIDLER'S LETTER.

To the Editor of "The Times":

SIR: As one of the deputation of members of the Newcastle Labor Electoral Organization who recently waited upon Mr. John Morley, M. P., to ascertain his opinions on certain political and social topics, I was intrusted by my fellow-members of the deputation with the question of the nationalization of the land, and this subject I discussed with Mr. Morley. In doing so, I sought to back up my position by quoting the ninth chapter of "Social Statics," by Mr. Herbert Spencer, and I certainly thought I had a good case when I found on my side the most distinguished authority of our time. To my great surprise I now find that in the letters which he has addressed to you, Mr. Herbert Spencer appears to be very anxious to repudiate the doctrines which he preached so eloquently in 1850. Now, although it is a common thing for the politician of to-day to repudiate principles and deductions which he formerly warmly espoused and to adopt others which he once energetically condemned, one does not expect the same vacillation on the part of a distinguished philosopher like Mr. Herbert Spencer. I find it difficult to understand his position, which seems to be this—that while adhering to his general principles he abandons certain deductions therefrom. Now, to my mind, the ninth chapter of "Social Statics," which deals with "The right to the use of the earth," seems as
logical, and as unanswerable an argument in favor of the
ion of the land as it doubtless appeared to Mr. Her-
the day it was written. Let us trace the course

of his argument through the ten sections of which the chapter is composed:

1. Given a race of beings having little claims to pursue the objects of their desires, and a world into which such beings are similarly born, it unavoidably follows that they have equal rights to the use of this world. Conversely, it is manifest that no one, or part of them, may use the earth in such a way as to prevent the rest from similarly using it.

2. Equity, therefore, does not permit property in land. Otherwise, landless men might equitably be expelled from the earth altogether.

3. We find yet further reason to deny the rectitude of property in land. Violence, fraud, the prerogative of force, the claims of superior cunning, these are the sources to which titles may be traced. Could valid claims thus be constituted? Hardly. If not, what becomes of the pretensions of all subsequent holders of estates so obtained?

4. Not only have present land tenures an indefensible origin, but it is impossible to discover any mode in which land can become private property. Cultivation can not give a legitimate title.

5. Why not agree to a fair subdivision of the land? Until we can demonstrate that men born after a certain date should be doomed to slavery, we must consider no such allotment permissible.

6. Either men have a right to make the soil private property or they have not. No compromise is possible. If they have such a right, then the Duke of Sutherland may justifiably banish Highlanders to make room for sheep-walks.

7. After all, nobody does implicitly believe in landlordism. If a canal, a railway, or a turnpike road is to be made, we do not scruple to seize just as many acres as may be requisite. If we decide that the claims of individual ownership must give way, then we imply that the right of the nation at large to the soil is supreme.

8. To what does this doctrine, that men are equally entitled to the use of the earth, lead? Instead of being in the possession of individuals, the country would be held by the great corporate body—society. Instead of leasing his acres from an isolated proprietor, the farmer would lease them from the nation. Clearly, on such a system, the earth might be inclosed, occupied, and cultivated in entire subordination to the law of equal freedom.

9. No doubt great difficulties must attend the resumption, by mankind at large, of their rights to the soil. The question of compensation to existing proprietors is a complicated one—one that perhaps can not be settled in a strictly equitable manner. But there are others besides the landed class to be considered. The rights of the many are in abeyance. To deprive others of

their rights to the use of the earth is to commit a crime inferior only in wickedness to the crime of taking away their lives or personal liberties.

10. The right of each man to the use of the earth, limited only by the like rights of his fellow-men, is immediately deducible from the law of equal freedom. The maintenance of this right necessarily forbids private property in land. The theory of the co-heirship of all men to the soil is consistent with the highest civilization, and, however difficult it may be to embody that theory in fact, equity sternly commands it to be done.

In the foregoing digest, beyond one or two connecting words, the language is that of Mr. Herbert Spencer himself. Does it not constitute an unanswerable argument in favor of the nationalization of the land? If the author would permit it to be reprinted, what an admirable tract the ninth chapter of "Social Statics" would be for the propagation of Socialistic principles! But he now seems to repudiate the offspring of his own genius! We have, however, a right to ask that, instead of a vague repudiation in general terms, Mr. Herbert Spencer should tell us specifically what deductions he has abandoned and why he has abandoned them. We might then endeavor to answer his answers to his own propositions. Yours,

JOHN LAIDLER, *Bricklayer.*

TWO AND A HALF PER CENT.

BY GEORGE ILES.

THE fall in the rate of interest is one of the most striking facts in the financial history of this generation. At times the price of money has risen, and investors have hoped that the good old rates were to be a permanency; but interest has soon declined again, vibrating about a point a little lower than the center of its former seesaw.

Last April, the city of New York, in purchasing certain uptown parks, sold stock bearing 2½ per cent per annum, maturing in twenty years, and exempt from city and county taxation. The stock, $7,457,000 in amount, brought on an average $100\frac{3}{10}$. High as the credit of the metropolis stands with investors, still higher stands the credit of the United States. Its bonds last April netted a return at current market prices of but 2·07 per cent. During the decade ending with January, 1889, the average rate realized on a United States Government bond was 2·72 per cent; during the preceding ten years it was 4·06 per cent, very nearly one half more. Comparing the nine years and nine months ending October 31, 1889, with the decade preceding, the rate of discount charged on prime commercial paper by the banks of New York city declined from an average of 6·23 to an average of 5·29 per cent. The Bank of England's rate concurrently compared shows the relatively small diminution of from 3·40 to 3·28 per cent.*

As far as concerns the manufacturing and trading public who obtain credit at banks in the United States, the decline in the rate of interest has been slight. It has been very different with regard to returns obtainable from investments of the highest class, such as those offered on the bonds of the United States Government, and of the great cities with credit unsmirched by traditions of bankruptcy or repudiation. An investor in a Government bond has certainly a form of property wherein the cares of ownership are brought to the vanishing-point. His security is absolute; his bonds are registered, so that he need fear no thief; he can sell all or any part of them at pleasure; and, should he desire to pledge them for a loan, no operation is simpler and easier. Still, two things remain to be desired—the perpetuity of the obligation, and a larger supply of the securities. In a term of years, all too brief, the bonds will be paid, and the question of reinvestment will come up, perhaps to be settled by heirs and assigns who may be tempted by a shrinking rate of return to accept securities which are no securities. Railroad financiers have noted the demand for permanency in investments, and have profited in supplying it. For example, certain permanent debenture stock issued by the Canadian

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*	Rate realized on U. S. Government bonds at average January prices.	Rate of discount charged by banks in New York city for prime commercial paper; average for year.	Bank of England's rate of discount; average for year.
	Per cent.	Per cent.	Per cent.
1870	4·86	8·08	3·44
1871	5·28	6·13	2·88
1872	5·06	6·38	4·09
1873	4·50	9·92	4·89
1874	4·58	5·98	3·69
1875	3·94	5·51	3·23
1876	2·28	5·12	2·61
1877	2·40	5·21	2·91
1878	3·69	4·81	3·78
1879	4·00	5·19	2·50
1880	3·75	5·33	2·76
1881	3·25	5·19	3·48
1882	3·00	5·67	4·15
1883	2·87	5·56	3·57
1884	2·60	5·40	2·96
1885	2·63	4·18	2·92
1886	2·50	4·95	3·05
1887	2·23	5·79	3·34
1888	2·28	4·87	3·30
1889	2·07	...	...
1889, January 1 to October 31	...	5·91	3·25

Pacific Railway Company, is quoted at 123; certain other of its bonds, equally well secured, but payable in 1937, are quoted at 110; both bear five per cent. Investors of the wealthiest class prefer investments which, while absolutely secure, may be subscribed for in blocks of a quarter to a round million—a desideratum which further restricts their choice. An electric current may be so intense as to become an obstacle in its own path; a vast volume of capital in the hands of an individual has somewhat the same effect.

While the rate of interest on Government bonds, and city and railroad debentures has been steadily falling within the past two decades, the rates payable on real-estate mortgages have declined in sympathy. This year, in New York and Boston, liens on the best city property have been placed at four per cent, two per cent less than the rates current in 1869. In other large cities of the Union a similar decline is observable; and, as between newly settled States and Territories and the financial centers of the nation, the disparity in the rates payable on well-secured loans is much less to-day than it was twenty years ago. The significant point in the matter under consideration is not so much that the rate of interest has been falling as that interest has become distinctly separated from the wages of superintendence and the premium for incurred risk, which used to be combined with it. The return on a Government bond represents the bare remuneration of capital employed, without hazard or care. An investor in first-class city mortgages receives a larger income than if he had bought Government bonds with his money, but he has not so easy a time of it. He must have titles carefully and responsibly examined; his creditors may be unpunctual; occasionally he may have the trouble of a foreclosure on his hands. His investments are for comparatively short terms of years, and, between one investment and another, part of his capital may be unproductive; or, in reinvesting, he may be obliged to accept a reduced rate. Hence the competition for securities eliminating hazard and bother, which is one of the notable facts in the modern world of finance. Many causes have been at work in bringing down the return on a New York debenture to five eighths as much as can be obtained on a Fifth Avenue or Broadway mortgage. First of all, of course, must count the enormous growth of American wealth within recent years; and, next, the fact that a good deal of it is in the hands of comparatively few men. A multi-millionaire's income, even at the lowest current percentage, is so much more than his outgo that, if he can be relieved from care and anxiety in looking after his possessions, he is often content to buy securities paying but half as well as the best properties did twenty years since. Another prime cause for the fact under notice is the steady approximation to European rates of interest which has been going on since the close of the war. With trade restored to its normal channels, and a steady reduction in the national debt, have come a constant appreciation in national securities. Ever-improving means of intercourse by steam and telegraph have brought about a better knowledge in Europe of other leading American investments, and a competition for them which makes the London demand in substantial sympathy with that of New York. Meanwhile, too, European rates of interest have fallen; in 1887 Germany was able to convert her 3½'s into 3's; last year Great Britain refunded a large portion of her debt, which had borne 3 per cent, at 2¾, with a liability for but 2½ after a certain term. Among the consequences which have followed the diminution of income from secure European investments has been the invasion of the American industrial field by European capital. This invasion, partly prompted by the fear of continental war, in seeking to add profit to interest, must both tend to increase commercial competition in America and contribute to further lower the rate of interest. A fact recently presented by Mr. M. A. Neymarck, the French economist, is worth mentioning in this connection: when the existing redeemable debts of France, of Paris, and of the French railway companies are paid, the redemption prices will exceed the issue prices by $1,300,000,000.

While the progress of science, applied to developing the resources of this country, has prodigiously increased its capital, the ratio of it offered for safe investment has increased at the same time. Savings-banks, trust companies, building associations, insurance companies diverse in type, afford, as it were, a thorough system of conduits to bring every tiny rill of saved earnings to some great reservoir of accumulation. Despite America's increase of population, there are now, probably, fewer hoards of money in its old stockings than ever. When tenders for city, county, State, or railroad bonds are opened, it is usual to find that the majority of competitors are trust companies, savings-banks, and other concerns representing small investors, whose demand first and chiefly is that their security shall be unquestionable. To this numerous class a vitally important inquiry is, Are we to expect a rise or a fall in the rate of interest? In considering this question it will be enough, in passing, to say that abnormal influences affecting the rate of interest are the remote contingencies of foreign war or civil commotion; the normal influences are chiefly four:

First, the comparative efficiency or reproductive power of capital; next, its security, depending on the character and ability of those who handle it; third, its supply and demand; lastly, the soundness of the currency, assuring the repayment of loans in undepreciated money. With respect to the first factor, a glance is enough to show it to be two-sided. In the new South and new

West, virgin forests, prairies, and mines offer as splendid opportunities to enterprise as enterprise has ever known; so far, therefore, the demand for capital to develop these new resources will tend to raise, or at least to conserve, the rate of interest. While this is true, it must be remembered that a given amount of capital is more efficient now than it ever was, that its efficiency increases; which means lessened demand for it, tending to reduce the terms paid for its use—unless new and profitable applications of capital can be made. As invention after invention is perfected and introduced, the outlay for machinery required to make a million pairs of shoes steadily diminishes. Quick and cheap railroad transportation enables a country merchant to keep his stock at a minimum by constantly "sorting-up"—reducing the capital needed for his business. Telegraphic purchases and payments now exclude the necessity for locking up capital while correspondence goes on through the post-office. In the vast stores of capital, set free in these and similar ways, arrives the opportunity for inventiveness, taste, and skill to create new wants, to supply them and some old wants as well which have long gone hungry—to increase the quantity and improve the quality of life. In so far as such new applications of capital are not commercially reproductive, they tend to maintain the rate of interest.

Next, as to security in investment. During recent years there has been an immense growth of American capital in the hands of people unable or unwilling to superintend its application in business, people in the main desirous of thorough security in their investments—many of them executors and trustees. Financiers have not failed to observe this state of things; it has enabled them to obtain vast loans at comparatively low and diminishing rates. Of late years have appeared innumerable issues of bonds, debentures, and mortgages; covering not only railroad property, but mills, elevators, apartment-houses, office and club buildings. When the loans obtained by these wholesale borrowings have been remuneratively applied, the result has been all that the lenders could wish. But, unfortunately, the securities which warrant a buyer in dismissing caution and the necessity for discrimination are few indeed. The popularity of coupon bonds has extended from those of a substantial description to many of little or no value. During the year ending June 30, 1888, twenty-one per cent of the bonds outstanding on American railroads paid no interest; the capital involved being no less a sum than eight hundred and twenty-seven million dollars. Of allied significance is the fact that in 1888 one in every ninety-eight firms in business in the United States became insolvent. Despite improved methods of transacting business, of estimating credits through mercantile agencies, there persists an overtrading which burdens the community with a heavy tax for bankruptcy. That administrative ability is much rarer than opportunities for its exercise is clearly one of the causes for low interest, and for the addition thereto which bankers and other lenders must charge in order to cover commercial risks.

The third influence bearing on the rate of interest is the comparative scarcity or plentifulness of capital. This is determined not only by the amount and efficiency of capital productively employed, but by the ratio of reproduced capital which is saved. Taking it by and large there seems no reason to believe that habits of thrift are losing their hold on the people of this country. As will shortly be seen, the returns of savings-banks bear this out. If persons of small capital are exposed to a reduction of interest from the safest forms of investment, this very liability may lead to greater thrift among those of forecasting mind. Where accumulation is quite too small for its income to yield a living, it is the capital sum that is looked to as a resource against a rainy day.

Lastly, as to the soundness of the currency. While "the consensus of the competent" holds that there is the menace of financial derangement in the legal-tender decision of the Supreme Court of the United States, and in the silver legislation of Congress, neither of these seems as yet to have affected the rate of interest. To provide against the contingency of a depreciated currency, whether fiat-paper or silver, now sought to be artificially bolstered in value, certain loans of large amount have recently been effected in Wall Street with the express stipulation of payment in gold coin. The precaution is significant.

Refraining from any attempt to weigh and balance others of the multifarious influences working for the depression or elevation of the rate of interest, it may be enough to say that the prevailing impression among both economists and men of business is that downward influences will probably continue the stronger in the years of the near future. This means hardship to many worthy people whose time of competence it postpones indefinitely; hardship, too, for the class who, unable to accept business risks or manage business investments, must needs accept less and less return from a little capital. Small comfort for them to hear that prices are falling, so that their loss of income is largely or wholly offset: does not rent rise constantly, and does not the [illegible] "necessities" expand the while with an imperiousness [illegible] be withstood? But, turning from cases of this kind, after all comparatively few, the reduction of the r
paid by secure investments is in the
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profits, if it also means

growth of large fortunes is likely to be slower in the future than it has been in the past; and the growth of large fortunes is in many quarters regarded as a menace to industrial and political freedom. That wages have in the main risen during the past twenty years is clearly shown in the statistics of the State and National Labor Bureaus. In many trades money-wages have advanced; in others, where they have remained stationary or fallen a little, their purchasing power has increased; in a few trades, superseded by newly devised machinery, and in the case of unskilled labor subjected to competition with hordes of immigrants accustomed to a low standard of living, wages have fallen below the purchasing power of those paid twenty years ago. No State in the Union adds to her population more immigrants of the wage-depressing type than New York; still, on July 1, 1889, her savings-banks held on deposit $536,417,974, due 1,389,907 depositors. The amount had increased $22,000,000 during the preceding twelve months, and $201,000,000 during the preceding nine years. These figures prove a rapid improvement in the condition of the working people of New York; and, since migration from New York to other States is easy and cheap, her advance in general prosperity may be fairly interpreted as gauging prosperity throughout the nation.

While, then, wages have been rising and interest falling, a new method has perforce entered into the management of large properties. It used to be remarked, as a characteristic of American engineering, that it presented not the best thing, but the lowest-priced thing that would serve. This is true no longer. Everywhere we find railroads adopting the most substantial types of construction and equipment. Steel rails long since replaced iron rails; now steel bridges are replacing wooden bridges; not only on trunk lines, but on local roads, large outlays are being constantly made for improved curves, gradients and ballasting. Already the increase in the cost of lumber, due to forest destruction, has brought in the experimental use of steel both for ties and for car-construction. A steel tie is dearer than a wooden one, but its life is vastly longer. The same principle obtains in mills and factories: net profit can be increased by a judicious increase of capital expenditure, which adds to the account for interest, but deducts a larger sum from disbursements for maintenance, repairs, and accidents. Cheap money for good security has, too, had much to do with the new architecture of our cities—architecture which employs granite instead of sandstone, substitutes sandstone and marble for brick, and demands brick of new durability and beauty. In quite modest dwellings it is now usual to find hot-water or hot-air furnaces instead of the heating stoves still general a decade ago; ranges and gas-stoves for cook-stoves; elaborate laundry appliances; electric bells—all intended to minimize service at the expense of an increased original outlay. If the occupant of a suite in a New York apartment-house, who has abandoned a self-contained house, is asked the reason, he will probably say, "I pay just as much rent, but I get along now with fewer servants."

The tendency observable on all hands to provide durability in the stead of flimsiness, the most elaborate and complete machinery for anything short of it, is accompanied by another tendency in no sense economical. When banks and office-buildings display floors of rich mosaic, walls and ceilings of variegated marble, staircases of Mexican onyx, it is evident that luxury brings a price as well as wholesomeness and commodiousness. Throughout the Union every considerable city has its structures of this type discovering the sky, mostly erected by insurance companies who seem to be hedging on the fall in the rate of interest by reaching out after unearned increment.

Rent has been affected in diverse ways by the cheapening of secure loans. In so far as mining privileges and the like can be worked with less cost for the hire of capital than ever, their net income, rent or royalty, has increased. Farming lands of all kinds but the best situated or the most fertile have tended to fall in rent as massed capital has become cheaper. Railroads, in opening up vast tracts of new territory with great rapidity, have kept the values of even the best farming land lower than they would otherwise have been. In the same direction also has operated the lowered rate at which money can now be borrowed on farm buildings and machinery. In the cities and larger towns rents have risen remarkably within twenty years, yet the rise would have been greater still had not the rate of interest dropped. Rent in cities and towns, as elsewhere, depends upon two values—that of land apart from improvements, and that of improvements. The first of these values is determined by the comparative salubrity, publicity, convenience, and beauty of sites; other things equal, it will tend to rise as the income of the average citizen rises—with the increase of ability to compete for advantages desired. The rental value of improvements, of all that capital adds in preparing for a building, constructing it, and fitting it up, will tend to approximate to the rate of interest payable on approved real-estate security. In New York city, where land is usually more valuable than the buildings which cover it, low terms for mortgage interest have not affected rents so much as in smaller cities where buildings are as valuable as or more valuable than their sites. Last spring a block of tenement-houses in New York sold at a price so high as to realize its purchaser but six per cent as a gross return on his investment. If his rents remain unchanged, any further fall in the rate of interest will enhance the price of his property. This incidentally illustrates how as interest falls land values rise, and explains the growing appreciation of home-owning in cities and their suburbs.

According to the statistics of the Interstate Commerce Commission, the bonded, share, and floating liabilities of American railroads amounted to $8,129,000,000 on June 30, 1888.* It is not likely that science has any such revolutionary gift for mankind in the near future as the railroad; and as American capital at this time demands new outlets whereby to effect new economies or save noteworthy waste, it may be allowable to note some fields for sound investment as yet unoccupied. Is not the improvement of our towns and cities, as such, a field which capital might well enter? Recent investigations by Captain Francis V. Greene, of New York, and other experts, demonstrate that, were the city's pavements as good as they should be, horses could draw threefold greater loads over them, with an immense abatement of both noise and filth. While the improvement of the metropolis due to individual enterprise and taste has been marvelous of late years, its mansions and business structures vying with the finest in the world, the city as a city is little changed. Its gas, water, and sewer pipes are still laid in the earth beneath its streets, subject to unceasing disturbance for repairs. Its electric wires, for many years a grievous eyesore, a menace to pedestrians and an obstruction often fatal to its firemen, at last have so multiplied in number and deadliness that a beginning has been made in laying them underground—a tentative procedure attended with all the uncomfortable results of an underground piping for gas and water service. Repeatedly the suggestion has been made, echoed at last in the City Hall, that subways be constructed for the accessible disposition of gas, water, and sewer pipes, and for electric wires. Never until this suggestion is acted upon will the city's pavements be free from constant breaks, which, were repair of the carefullest, would never permit New York streets to remain smooth and seemly. Subways of the kind proposed could easily accommodate pneumatic tubes for the conveyance of postal letters and parcels. To-day the mails traverse New York, much as furniture and vegetables do, in common vans. So slow is their delivery that letters from Albany, arriving at the Grand Central Station at 7 A. M., reach Fourth Avenue and Thirty-second Street partly at 10.40 A. M., but in larger part between 12.40 and 1.10 P. M. The point named is half a mile from the station, on the way between it and the Post-Office. The quickest train from Albany to New York travels the distance, one hundred and forty-eight miles, in three hours and thirty minutes; a letter traversing a distance of six miles within the city occupies on an average five hours. Long ago the Western Union Telegraph Company connected its Madison Square branch with its headquarters on Dey Street: written messages are transmitted through its cylinders, two and a half inches in diameter, at the rate of a mile a minute. The tube in its course connects with three branch offices in Broadway—a hint for the pneumatic connection of branch post-offices with the general Post-Office, which, extended to the principal railway stations and ferry-houses in the metropolitan district, would give the postal service a new efficiency. More important than this pneumatic tubing is the question of rapid passenger transit, the inadequacy of existing methods being peculiarly impressive as the great exhibition of 1892 is discussed. Whether by tunnel or viaduct, it seems imperative that New York, at an early day, shall provide itself with transit facilities such as those of the German capital, where trains stopping at all stations, and trains running at high speed stopping only at the principal stations, run on separate sets of tracks.

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* Of this stupendous total, 39 per cent had made no return whatever during the preceding twelve months.

This continent is, after all, only a larger kind of island, and increase of transatlantic travel has been needed to remove some of its insular complacencies, especially that with which it has hitherto regarded the condition of its streets.

In common with New York, every city and large town in America requires what may be called integration—a thoroughly comprehensive and intelligently planned outlay of capital for every means of welding it into a unit—commodious, wholesome, and pleasant to live in; easy and cheap to get about in. There is an art of city design as well as house design: modern house planning not only bestows new comforts and refinements, it makes them all part and parcel of a whole. When cities and towns are treated structurally exactly as a good architect treats the edifice an unstinting capitalist asks him to create, life in them will be much better worth having than it is. And the financial opportunity to do all this appears when New York can borrow money at two and a half per cent—a rate one half as much as her citizens are obliged to pay for individual borrowings. What has been said with regard to cities and towns applies equally to means of communication between them and villages—the common roads, whose badness Prof. Shaler tells us imposes a tax of at least ten dollars a year on the average American household. Road improvement offers scope and verge for the profitable and safe investment of a good many millions now idle. Passing from matters of municipal and county administration to State and national interests, does not cheap and abundant capital make it possible to conserve the Adirondacks as a State park, and as the source of the principal rivers of New York; to establish a national system of afforestation; to reclaim the arid plains of the far West to fertility; to take in hand on broad lines the improvement of the nation's water-ways? Governments, honest and able, can do many things for the common interest which the people as individuals are powerless to do for themselves. Honest and able, there's the rub! The municipal administration of Berlin, a city well-nigh perfect in government, is carried on for a trifle more than the interest on the public debt of New York. Abounding cause is there to fear waste, corruption, and incapacity in any extension of governmental functions which the future may develop. Still, it is not so much fear of this kind which prevents that extension, as a lack of perception by the American people, governing and governed, of the great benefits that can follow the organized action of municipalities, counties, States, and the nation itself. There is much deploring of political degradation and political immorality: may we not reckon in the future, among the forces working for reform, that of capital wrongly excluded from vast fields of usefulness and profit?

THE RARE FORMS OF ORCHIDS.

By J. DYBOWSKI.

THE varieties of plants which, under various titles, charm us as house-ornaments, and give our habitations a character of freshness and life that is always dear to us, are already numerous. Right along with their growing number goes our increasing affection for them. They are not of the kind of things we tire of as soon as we become acquainted with them; but the more intimately we know them the more disposed we are to seek for new ones. They will never become common. We might suppose that, the more numerous rare flowers become and the more fond amateurs grow of them, common flowers would fall into neglect. But this is not so. We are not only fond of flowers because they are rare or precious, but we love them also for themselves and for the attractions of their own that they possess. In the grand army of flowers which seem made to impress a tone of the gay on the sober background of our existence, there are some stately ones that appear to constitute a kind of aristocracy of this enchanting world.

Such flowers are the subject of our present essay. The orchids, conquerors of the light, may well claim pardon for their triumph over their humble companions of the gardens, for their [illegible]y is fairly achieved. They astonish us when we first exam- [illegible] charm us. Nature has been liberal with them, [illegible]thing. Their flowers are full of that curious charm that captivates. Their colors are harmoniously toned, and always bright and elegant. Their odor is sweet and penetrating, but does not cloy. Notwithstanding their thin texture, which gives them a delicate and frail air, they last longer than other ornamental flowers. Nothing, in fact, seems to be wanting to them but a more lively and abundant foliage; and that can be supplied by mingling fern-leaves with them.

It was long supposed that these wonderful plants were extremely delicate and capricious. This was a mistake. To their other virtues they join the rare one of simplicity.

Nearly all the orchids cultivated in greenhouses are natives of the intertropical zone, and it was supposed from this fact that they required considerable heat. But it has gradually been established that a high temperature really hinders their best development. A considerable number of them in their native state grow on high mountains, under exposure to a bracing atmosphere; and they are now cultivated in moderately warmed and freely ventilated greenhouses. They are therefore relatively hardy plants, well adapted to the decoration of our rooms.

The genera and species of orchids already known are very numerous, but the varieties are more so. The cause of the multiplicity of form, shade, and appearance lies chiefly in the organization of the flower. Without going into technical details and descriptions, it is enough to say that the pollen is not spontaneously carried to the stigma, and that a foreign agent has to intervene in the fertilization of the seed. The office is discharged by insects, which visit the flowers for their honey and involuntarily load themselves with pollen; then, flying from one flower to another of different varieties and species, they effect all kinds of mixtures. Consequently, varieties are endlessly multiplied. While many of these may be common, others obtain special hues or streaks, which render them rare and cause them to be sought out by collectors. Now that orchids are in full favor, and are likely to continue so for a long time, enormous prices are paid for the choice varieties.

A *Cattleya* (Fig. 1), shown at a recent horticultural exhibition in Paris, had a light violet-blue corolla instead of the usual rose-violet. This sport in color was enough to raise the price of the plant to ten thousand or twelve thousand francs. The owner —M. Piret, of Argenteuil—had himself sought out the variety in the forests of Venezuela. The instance is not a rare one. At a recent sale in Ghent, every specimen of a certain *Cypripedium* brought six thousand francs; and like prices are often obtained in England. The ordinary prices in trade are, however, more moderate than this. As the result of numerous explorations, often made at great risk of life, orchids of all kinds and of the more usual varieties have been imported by thousands within the last few years, and are sold at reasonable prices; and the business of dealing in them returns little profit unless some of the rarer varieties are on the list.

While it is difficult and dangerous to go to their native haunts for orchids, it is not much more easy to possess the rarer varieties in cultivation; for, while the care of adult plants is comparatively easy, the raising of the seedlings is attended for many years with almost insurmountable difficulties. But cultivators have become possessed with the idea that it would be well to imitate with species selected for their beauty and good forms the accidental hybridizations of the forests. Many have tried; a few have succeeded. One of the first among these was M. Bleu, General Secretary of the French Horticultural Society. He cross-fertilized, sowed the seeds, and raised young plants. To appreciate the difficulties of these operations, they must be followed out. In the first place, the seeds are so fine that they can not be seen without a strong glass; they are sown on the bark of trees or in chopped moss; and they are transplanted when the plants are so small that the work has to be done by the aid of a magnifier. These material difficulties are still as nothing compared with the care that has to be given the nurslings to secure a good development of them. The cultivator may consider himself fortunate if he gets a few dozen good plants out of several thousand seedlings.

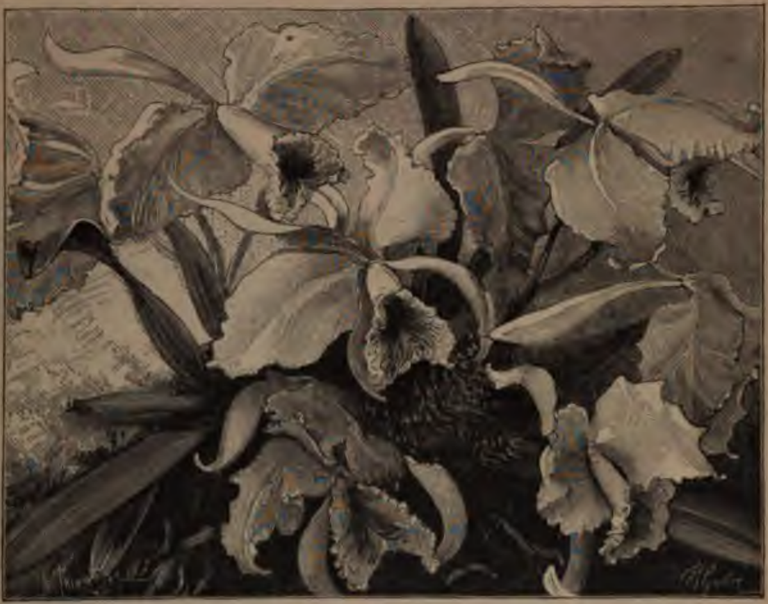


Fig. 1.—Orchids. *Cattleya nossia* (bluish mauve).

Orchids in all their varieties of aspect and form have very different ways of growing. Some, like the lady's-slippers (*Cypripedium*) and the superb *Odontoglossums*, are ground-plants; others, perhaps most of the class, are epiphytes, attaching themselves to the bark of trees, where they live at considerable heights above the soil. Of this class are the fragrant *Cattleya* and the splendid *Phalænopsis*, so elegant with great bunches of white or rose-colored flowers.

It follows from this great diversity of exigencies that orchids lend themselves readily to all possible combinations in the ornamentation of rooms. Some are cultivated in pots and help in the decoration of *jardinères* (Fig. 2); others, which live on the trunks of trees, can be placed in hanging baskets, or fixed in front of a mirror which will reflect their graceful figures.

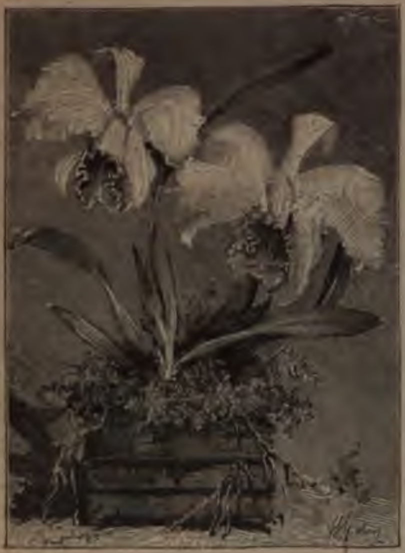


FIG. 2.—ORCHID-GROWING IN A ROOM.

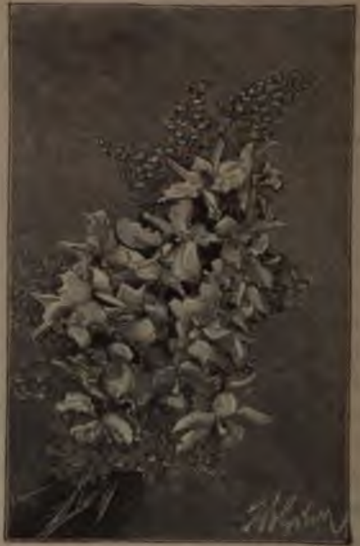


FIG. 3.—CORSAGE BOUQUET OF ORCHIDS.

Orchids will last a long time in a room if proper care has been taken in cutting and transporting them. The flower will sometimes keep its freshness for two or three weeks. Their preservation may be prolonged by covering them every evening with a sheet of silk paper, which will protect them from dust and excessive evaporation. They lend themselves remarkably well to the formation of bouquets, where their quality of keeping fresh for weeks gives them much value. An effective bouquet shown at a horticultural exhibition in Paris, which was formed by attaching orchids mingled with branches of asparagus to moss-covered bamboo sticks, is shown in Fig. 4. On account of their enduring freshness orchids are favorite flowers for bouquets to be worn on festive occasions, and a considerable trade has been developed in flowers for such uses. Favorite kinds for this purpose are the *Odontoglossums*, with handsome white, starry flowers, and the *Oncidium papilio*, with its butterfly-shaped corolla.

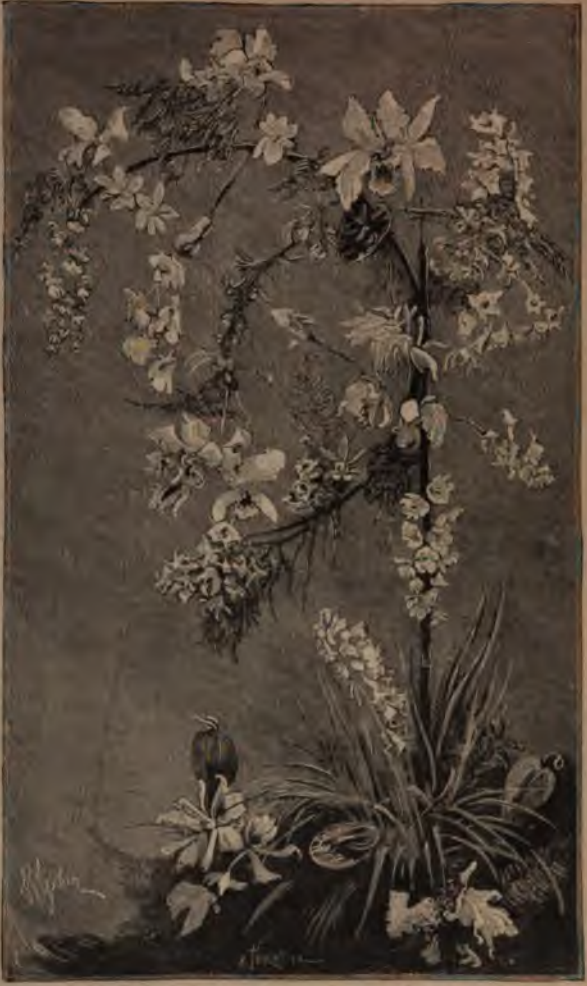


FIG. 4.—MOTIVE IN CUT ORCHIDS, MOUNTED ON BAMBOO.

The enormous sums that are often paid for orchids are decried as foolish, and the extravagance is sometimes compared with the craze that once raged about tulips. The two fashions are not to be compared; for there is something real and solid about orchids, which will always give them rank among the finest and most highly esteemed flowers; while tulips are not fine, and soon suffered a loss of the extravagant admiration that prevailed for them for a time. New varieties of the rose, although it is a very old flower, still bring higher prices than the rarest of orchids.—*Translated for the Popular Science Monthly from La Nature.*

ONE point of great interest observed by Dr. Nansen in his expedition across Greenland was the very low temperature in the interior, which seems to be in departure from the received meteorological laws. This may, he thinks, throw a good deal of light on the much-discussed question of the cause of the great cold of the Glacial period. No better place can be found for the pursuit of this inquiry than Greenland.

IRRIGATION OF ARID LANDS.

By HENRY J. PHILPOTT.

THERE is no more striking difference between the inhabitants of the Eastern and Western United States than the degree of their familiarity with the word *irrigation*. And there will never be a profounder difference than will be engendered by the thing itself. The Eastern farmer irrigates his cabbage and tomato plants when he first transplants them. His wife irrigates her flowers. The city gentleman irrigates his lawn. But the idea of watering a whole farm—not a New England "patch," but a Western ranch of from fifty to fifty thousand acres—seems a financial absurdity. What the Eastern farmer could not produce without such expensive cultivation he would say was not worth producing.

Equally incredible will seem farming without irrigation to the generation now growing to manhood over a large part of the Pacific coast. To them it will seem an absurdity not to have the water as fully under your own control as the land. They would not want to cultivate land if they had to take chances on there being neither too much nor too little rain.

What would surprise the Eastern farmer still more, if he knew it, is that thousands of acres of land, intended for nothing but hay and pasture, are not only irrigated from ditches a dozen miles long, but must first be leveled down with road-scrapers, and often the grading costs twenty-five dollars an acre. This, however, applies only to certain forms of irrigation. My present purpose is to describe a number of different ways of irrigation which I have seen exemplified on a large scale.

The simplest plan is with a street-sprinkler. It is profitable on certain crops of high value per acre. For irrigating trees and vines the spray may be taken off the wagon and a straight stream conveyed by a short hose to the roots. I have seen vineyards of one hundred acres watered in this way. It is chiefly used in tiding young vineyards and orchards over the first year, on land which thereafter will need no irrigation. It always struck me rather comically to see a street-sprinkler meandering over a field thirty miles from the nearest town, as if it had got lost and were groping about and trying to find its way back to its native haunts.

In such case the original source of the water may be a well or a mountain cañon. I confess it still staggers me to see the miles of iron pipe through which a stream of irrigating water must often be carried from the mountain spring to the nearest field whereon it is to be used. A two-inch pipe, by the time it is laid, costs anywhere in the neighborhood of one thousand dollars a mile.

Wherever the water comes from, it is usually conveyed into a tank or a reservoir, and then piped or ditched about over the farm wherever needed. A hand pump is a rarity in southern California. A windmill pumps the water into a high tank, which gives it the pressure needed for sprinkling. Hydrants are placed at the house, at the barn, in the garden, in the orchard, and at other points. With plenty of hose the fire protection is admirable. The farmer's wife is as well off as her city cousin in the matter of water conveniences.

Running through iron pipes near the surface of a blistering hot soil, the water gets warm, not to say hot, and so it does standing in the tank over the well. When wanted for drinking, it is put into a porous earthen jar called an *alla*, and the evaporation of the large part which soaks through the jar cools the contents. Always in the morning, and nearly always throughout the day, you can get a drink as cool as the stomach ought to have. Sometimes a barrel, covered with a cloth kept wet, is used for the same purpose.

The water thus piped to various points on the farm is sometimes carried from the hydrants through ditches which run along the highest parts of the ground. These ditches are the simplest possible in construction. They go winding about like natural streams. Sometimes a furrow of the large farm-plow answers every purpose. For the capillaries of the circulation the furrows made between the rows of vegetables in cultivating them are quite sufficient. When you have irrigated a few rows, a hoeful or two of earth applied to each furrow stops the water from them, and then the dam is removed farther down the main stream, and more rows are irrigated in the same way.

The method of irrigating trees is different. A circular depression, with a raised rim, is made about the tree. In a large orange orchard this is done with a machine—a kind of complicated scraper dragged around each tree by horses. The saucer thus formed may be fifteen or twenty feet, but is usually much less, in diameter. The water is turned into it from a hose or through a surface ditch. An orange grove never looks prettier than when thus prepared for irrigation. Sometimes, instead of the circular basin about each tree, small ridges are thrown up midway between the rows, in both directions. This makes a larger irrigated surface, and, of course, requires more water.

All these methods of irrigation are simply extensions of ordinary garden watering. I have seen two other quite different methods in operation. One of them is the simplest and cheapest, the other the most complicated and expensive of all.

In the former nothing is done except to dig a large ditch through the field, as near the middle as is consistent with its following sufficiently high ground, or between two fields, if both are to be watered from it. Through this ditch, or *zanje*, a slow stream of water is kept running. It soaks into the ground and percolates or "seeps" through it and thus sub-irrigates the whole field without any lateral ditches. Of course, this occurs only in peculiar soils. Its best exemplification is in Fresno and Tulare Counties, California. Sometimes a single ditch, nearly straight, will in this way irrigate one hundred and sixty acres.

The other method is exactly opposite. The whole field is flooded. Head-gates are placed along the main ditch, and from every head-gate a dike or levee is run across the field. Levees are also run along the sides, one of them forming the outside of the ditch. If these levees ran at right angles, a field thus prepared for irrigation would look for all the world like a huge printer's case. The levees may be two to four feet high. The intervening spaces are called "checks," and may contain any amount of land. I have seen one thousand acres cut into checks of from one to ten or twenty acres. I did not see how it could pay. Nothing was grown but hay and pasturage.

The checks are leveled, if not already sufficiently level. They are flooded one at a time. In flooding check No. 1, head-gate No. 1 is opened and No. 2 closed. As soon as the whole surface of this check has been covered with water, head-gate No. 2 is opened, and the same flood runs back into the ditch and down into check No. 2, and so on. The water is kept on the land but a short time. In warm weather the flooding is done mostly at night. The basins or checks formed by the dikes are not filled with water.

Alfalfa hay is cut four or five times a year, and the land is flooded after each cutting. Twelve tons a year per acre are not a rare crop, though less is commoner than more. For wheat and other cereals one good flooding is enough.

A good deal of California land has been over-irrigated. Alkali has been brought on or brought up, the soil has been made heavy, pools have been formed from the "seepage," and orchards and vineyards have been spoiled. After a field has been irrigated for a few years it becomes saturated, and wells dug in it soon reach water. It no longer needs so much water, and its former supply may be carried on to reclaim new deserts. How much a single river will reclaim, only give it time enough, can be vaguely guessed. Thousands of acres in the San Joaquin Valley have been placed beyond the need of further irrigation. The whole valley was once a desert.

A part of it seems beyond the reach of any irrigation except what can be done during the rainy season. The Coast Mountains do not furnish living streams, and the Sierra Nevada water must run up hill to cross the valley and climb the western slope. How to get it over there is a problem vexing many minds. Several companies have been formed, and surveys have been made, for doing the work on different plans. One company proposes to lay iron pipes about fifty miles, at a cost of several millions of dollars. Another would carry the water in an open ditch above ground. At the lowest part of the valley-trough the ditch would have to be at least fifty and ought to be at least one hundred feet above ground, for several miles.

Under a new law of California, irrigation districts may be formed, and a vote taken as to what, if any, mains shall be constructed. A majority of residents rules. The minority, if they own land, help foot the bill. So do all non-resident land-owners. The district where these great iron pipes aforesaid are proposed would contain about eight hundred thousand acres. It was estimated that five dollars an acre would pay the cost. A gentleman interested as a landholder, however, assured me that his honest estimate would be not less than two hundred dollars an acre. With plenty of water the land, now practically worthless, would be well worth one hundred dollars an acre.

It will be readily admitted that such gigantic schemes of irrigation as these must raise new questions of both civil law and political economy. The constitutional conventions of the newly admitted States spent some time in wrestling with the problem of water rights. In all our arid regions property in land involves property in water. If by going higher up the river or cañon your neighbor may divert and use the water you have depended on, he might as well be permitted to take your land also, for it is valueless without the water. Litigation over these water rights has already given the California courts much to do, at heavy expense to litigants.

The rights themselves vary. In some cases one man or corporation owns the water, while another merely has the perpetual right to a share of it on the payment of a reasonable rate. But this right pertains to a particular body of land, and not to the person. In other cases each landholder is a shareholder in the water company. The difference appears on the face of the stock certificate. In the former case the name of the association which has tapped, say, the Alpine Cañon, will be "Alpine Water Company," while in the latter case it will be "Alpine Land and Water Company."

There are a good many of these land and water companies composed of farmers. Here is a new element introduced into farm life—an element of business and of co-operation. Sometimes it involves also an element of clannishness; as, when two such companies fall to fighting over the same supply of water. In fact, as I have already observed, this necessity of irrigation will make the deepest of all the differences in personal character and habits of thought between the East and the West. Nobody will doubt that the institution of property in land has an important influence on character. Why not, then, property in water? And while this may be said to exist in the East, it is rarely thought of, while in the far West it is the thing most thought of and talked about. It is the main factor in human sustenance.

The result is bound to be that East and West will take different views of life. Hence they are likely not to understand each other. At present this makes the less trouble, from the fact that the East can so easily outvote the West. I mean, of course, the arid West. I think it a safe proposition that, when the country is all settled to a density everywhere corresponding with its fertility, the arid lands will outvote the regions needing no irrigation. And long before that time they will hold the balance of power.

Already the irrigants have secured from the non-irrigants the concession of an appropriation for surveys, and the appointment of a senatorial committee, which is now on its travels, studying the advisability of a great system of irrigating reservoirs to be built, or at least surveyed, at national expense; and in the latter case the demand will doubtless be for such disposal of the affected public lands as will make it worth some private citizens' while to construct the reservoirs.

The desert-land act was intended to be a step in that direction. Under that law, the man who irrigates a square mile (six hundred and forty acres) of desert land within three years after filing his entry, may buy it at one dollar and twenty-five cents an acre. It must be land not capable of producing crops without irrigating, and twenty-five cents per acre must be paid at the date of entry. By the operation of this law, and by purchase of adjoining railroad lands, a single firm has acquired the ownership of four hundred thousand acres of as good land as ever lay out of doors. The owners have carried over it the most gigantic system of irrigation on this continent. They have divided up the waters of Kern River, and spread them out into a great artificial delta. They have now begun to sell their lands in small lots of ten, twenty, forty acres, and so on. I attended one of their auction-sales, and saw land, which ten years ago was uninhabitable desert, knocked down at fifty, a hundred, and even a hundred and fifty dollars an acre. The water rate is extra, and is so much per inch used. An inch is the amount that will run through an orifice an inch square in the course of a year, under a four-inch pressure.

The desert-land act was not intended to put such large bodies of land in the possession of so few men. But any law is apt to work that way. Where the stock of the water company is held by all the land-owners using, the land is often hypothecated as security for the assessments, and in default of payment could only fall into the company's hands. What sort of land monopoly will grow up under it, the whole business of irrigation is too new to foreshadow. There is a bitter feeling already against certain large owners and syndicates. But it is doubtful whether the still heavier enterprises of damming waters up in the cañons will ever be carried out by private purses, unless those who go into them are well assured of fee simple in still larger bodies of land. And that, I judge, is about what far Western people mean when they say they don't want the Government to dam the waters, but only to "encourage private enterprise."

The landscape effects of some of these irrigating systems are quite striking; sometimes pretty and sometimes depressing. Many of the main ditches are fifty feet wide. Such a stream of water, or a much narrower one, must form no insignificant part of the picture on the eye of the traveler. If it is straight, sluggish, green, bare, it may be a nightmare in its oppressive ugliness. But where it winds about like a natural stream, as it often does in order to keep on high ground, and is shaded by trees planted hap-hazard along its banks, it is a thing of beauty.

You drive along a lovely lane, lined on both sides by tall poplar-trees, between fertile fields, gardens, orchards, shady groves, and now and then you come to one of these artificial brooks. You may have to go up hill to cross it. In fact, the sides of the ditch are naturally and properly above the level, so that the water will run out over the land. So you have the funny sensation of crossing a creek on a hill-top, and even then driving upward to get over it. The bridge is natural as life, and likewise the mill-dam and the mill. A drive through the country between Hanford and Fernone is as pretty as the imagination can picture it. Its beauties are wholly artificial. Ten years ago that was a desert; to-day it is ahead of the Mohawk Valley in everything that goes to make a fine-looking agricultural region. Its one fault as a landscape is that it is as level as a billiard-table.

It is a disputed question whether irrigation induces disease. Certain it is that the irrigated portions of the San Joaquin Valley are malarious. But Mr. Nordhoff says they are less so than before they were irrigated. I have talked with some hundreds of the inhabitants, and they seem as a rule to think otherwise. They do say, however, that there is an improvement in the general health since they learned to drink deep-well water instead of the surface water which seeps through from the ditches. Some neighborhoods have artesian water. The whole valley is hot as a furnace, and the steaming canals probably make it seem hotter than it would, and may breed malaria as well as frogs and mosquitoes.

The Secretary of the Interior is reported to have sent an agent to Europe to study the subject of irrigation. We have a corps of engineers and a senatorial committee studying it in America. On the whole, it looks as if we ought to find out something about it. I have made a special study of it, and find it quite interesting. There is, perhaps, no more striking application of science to agriculture. You must know how to compute the mass of water that will flow through a ditch of a given size with a given fall. You must also know how much water will irrigate your particular piece of land. This will depend on its character as well as its size, and also on its annual rainfall.

It is astonishing how much the commonest Californians know about rainfall records. Rain-gauges are kept everywhere. The morning after a shower the farmers, instead of merely informing one another that it has rained, fall to talking of the quantity—and there is a good deal of sense in that. "My gauge showed fifty-seven hundredths of an inch," says Farmer Jones. "That makes 11·24 inches we have had this season," says Farmer Brown; "last season up to this time we had 13·42." And then they discourse of the precipitation yet needed to produce a crop without irrigation, or with partial irrigation, and the amount of irrigating water that will be required. The morning paper will give the rainfall in hundredths of an inch for a number of points throughout the coast country.

The size and strength of dams, head-gates, levees, etc., are matters requiring mathematical calculation of a delicate kind. Johnstown tells with terrible earnestness how important it is that these calculations should be to the last degree accurate. A careful survey of the route of each important ditch is also necessary. In fact, a number of sciences are involved in irrigating, but "practice makes perfect." Little by little the Western farmers are learning to depend more on cultivation and less on irrigation. They find it better in many ways; they now irrigate a greater area with the same amount of water. This hastens the day when the much-talked-of storage will pay.

What ought the Government to do in the premises? Tax the East to dam the West? I should say not, unless the expense were recouped. Perhaps it might construct the works and increase its prices on the land benefited. It gives lands to railroads in alternate sections, and then gets even by doubling the price of its own lands. What sort of a plan would it be for Uncle Sam to follow the example of the land-operators above mentioned—irrigate his land and sell it off at auction? He might sell it on sealed bids.

I should not much wonder if he could in this way make a handsome speculation.

Since the above was written, I read in the dailies that Secretary Noble has been informed that speculators are following in the wake of the Government surveyors, and trying to secure land and water titles; and that the Land-Office has been instructed to inform its registers and receivers throughout the arid regions that no such business will be allowed, but that the Government will retain control of these rights. This is a matter of several hundred times more importance than one Eastern man in a dozen will dream of.

PALM-TREES AND THEIR USES.

BY M. J. POISSON.

AFTER the grasses, with their various adaptabilities for the purposes of food and the arts, the palm-trees hold the first place; and this, not only on account of the uses for which they are fit, but also by reason of the beauty and amplitude of their foliage and the stately size which many of them attain. Their worth in decoration and their usefulness have been celebrated in all times and in many languages. In the time of Linnæus, eight or ten species, belonging to half a dozen genera, were known. At this time the number of determined species exceeds a thousand, and these are distributed among about one hundred and thirty genera. In a short article like this we can only touch upon the subject and indicate the principal useful species.

The date palm was the one of most interest to the ancients. It is the fortune of the peoples of northern Africa and the ornament of the oases of that region. It sports into numerous varieties, which are easily obtained from the seed. When quarrels arise between tribes, the first thought of the hostile factions is to ruin their enemies by attacking their date crops. The male and female flowers being borne on different trees, a few male plants are sufficient for the fecundation of a great many females; and the destruction of the former—not a very hard task—will make the latter worthless. Date-trees the fruits of which are not palatable are used for building purposes, or for making palm-wine—the fermented sap, which is drawn from the tree by tapping it as we tap maple-trees. The sap is also much drunk fresh, when the Arabs call it *lagmi*. The dates are eaten directly, or their expressed juice is used for sirups and flavorings. Those which, because of being grown too near the sea or in unfavorable situations, as at many places in the regency of Tunis, do not become fully ripe, are mixed with bread and fed to horses and cattle.

The dwarf palm of Algeria and southern Spain (*Chamærops humilis*) is not a profitable sort, but is rather a detriment to the Algerian plains. When it gets possession of a spot, it is very hard to exterminate, and the place becomes little to be preferred to the desert. The palm lands have, however, been cleared to a considerable extent since the French occupation of Algeria. The leaves are used in making brooms, baskets, and minor articles, for paper pulp, cords, and "vegetable hair."

The tender, plump buds of many species of Indian and American palms supply a choice food which is called "palm cabbage." The young tissue, which is very like salad-heart, is eaten raw or cooked and seasoned in different ways, or pickled. The leaves that are large enough are used on the roofs of houses or in the manufacture of a diversity of articles. Hindu characters are sometimes traced with a bodkin on strips of the leaves of the fan palm (*Corypha*) of the Indian islands, and these are folded like letters and sent in the mail. The flexibility of the leaves adapts them to many purposes of art. From the young leaves of the coco (*Lodoicea seychellarum*), whose enormous and strange-looking fruit is an object of curious interest, the natives of the Seychelles Islands make some handsome basket-work. The extremely light and durable hats called Panama are made from the leaves of species of this family. The pellicle of the leaves of the *Raphia*, or sago palm of Madagascar, from which the natives of that island make fine cloths, is used for ties in gardening and in the manufacture of artificial flowers, and is good for many other purposes.

Bridges over torrents and small rivers are made of the solid trunks of palm-trees. When the wood is fine and close, it is split into pieces that are turned and polished. Highly esteemed umbrella-handles — called laurel handles—are made from several kinds. If the central part of the stem is filled with tender pith, not too much stringy and tough, it is collected as sago; of which the sago palm of Madagascar and the corresponding regions of Africa affords the most highly prized quality.

Stems of small diameter are equally desirable. The jungles in the East Indian Archipelago—Java, Sumatra, and the peninsula of Malacca—abound in climbing palms or palm vines, the stems of which wind among the limbs of the trees to the top. Some have been measured that were a hundred yards long before they became interlocked with the network of the forest. They are the rattans (Fig. 4) which are so handy where a cane or any kind of flexible stick is wanted. Chairs are caned with the outer part of the rattan, and from the rest of the stem children's chairs, baskets, and many useful articles—including even dish-cloths—are made. The author of this essay has had considerable success in making such ornamental articles as earrings, scarf-pins, etc., out of the handsome fruits of some of the rattans. And the continued abundance of wild beasts, like the tiger, etc., in the East Indian forests, in spite of the activity with which they are hunted, is explained by the growth of rattans which make the jungle impenetrable to hunters.

FIG. 1.—ARECA LUTESCENS—a young specimen in pot, to show the ornamental character of small palms.

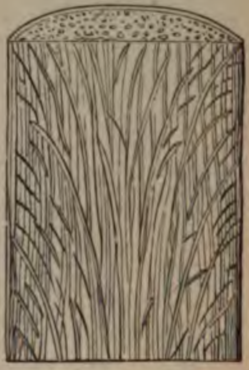


FIG. 3.—PALM-STEM IN SECTION.

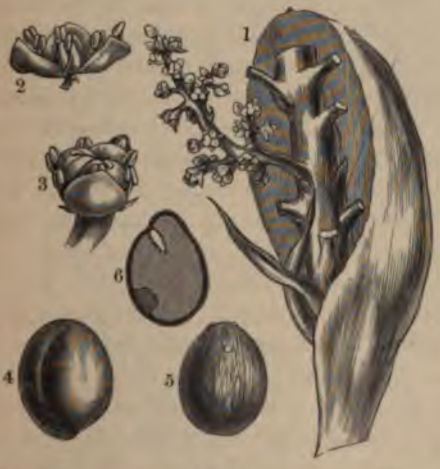


FIG. 2.—INFLORESCENCE AND FRUIT OF PALM. 1. Spathe and portion of spadix of Chamærops. 2. Staminate flower. 3. Pistillate flower. 4. Fruit. 5. Seed. 6. Seed cut vertically.

FIG. 4.—RATTAN PALM (*Calamus rotang*).

Some palm-trees furnish a sweetening juice. The most famous of these is probably the *Areng*, or sugar palm of Amboyna (*Arenga saccharifera*), which grows in India and the archipelago. It is a superb tree, with pinnate leaves twenty-five feet long, and is as handsome as it is useful. A number of species belonging to different genera furnish a kind of hair of finer or coarser texture. It is found in the fibrous sheaths of the leaf-stalks and in the jagged edges of the leaves. Cables made of the black, tough fibers of the *Areng* are preferred by the coasting sailors of the Spanish colonies on account of their elasticity and durability; and they are, moreover, very fine. The hemp palm of Japan and China (*Chamærops excelsa*, Fig. 5) is available in the hands of the industrious people of those countries for making the finer brooms, light strings, and a thousand articles of daily use. Palms of coarser fiber, like the *Piaçaba* of Brazil (*Leopoldina piacaba*), furnish material for blinds, brushes, brooms, and the rollers of mechanical sweepers, which are much more durable than rollers fitted with steel teeth. A waxy exudation forms on the trunks of the wax palm of the Andes (*Ceroxylon andicola*) and is collected by the natives for purposes of illumination. The *Carnauba* of Brazil (*Copernica cerifera*) forms a cerous efflorescence on the inside of its leaves. The natives climb upon the trees of the latter species and beat the leaves with rods, when a fine snow falls from them and is collected on cloths spread upon the ground for the purpose. The wax of the *Carnauba* is used in commerce, both by itself and associated with other similar substances.

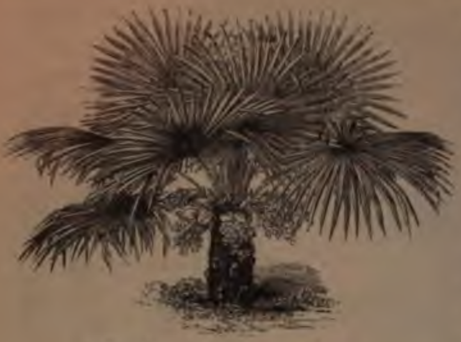


FIG. 5.—CHAMÆROPS EXCELSA.

The fruits of the palm are inferior to none. Every child knows what Robinson Crusoe did with his cocoanuts. After dates, this is the most generally diffused fruit of the palm. No drink is more in demand among the creoles and blacks than the milky kernel of the green cocoanut. When the fruits reach us, the albumen has hardened and become somewhat tough and indigestible. This nut is one of the sources of wealth—in some cases, perhaps, the only one—of the coral islands of Oceania and some other tropical regions. With the top in the sun and its roots bathed by the sea-waters—its favorite station—the cocoa-tree (*Cocos nucifera*) continues in good condition to the age of seven or eight hundred years. The dry nut, called *copra*, is marketed by the thousand tons every year, to be employed in various uses for which fats are

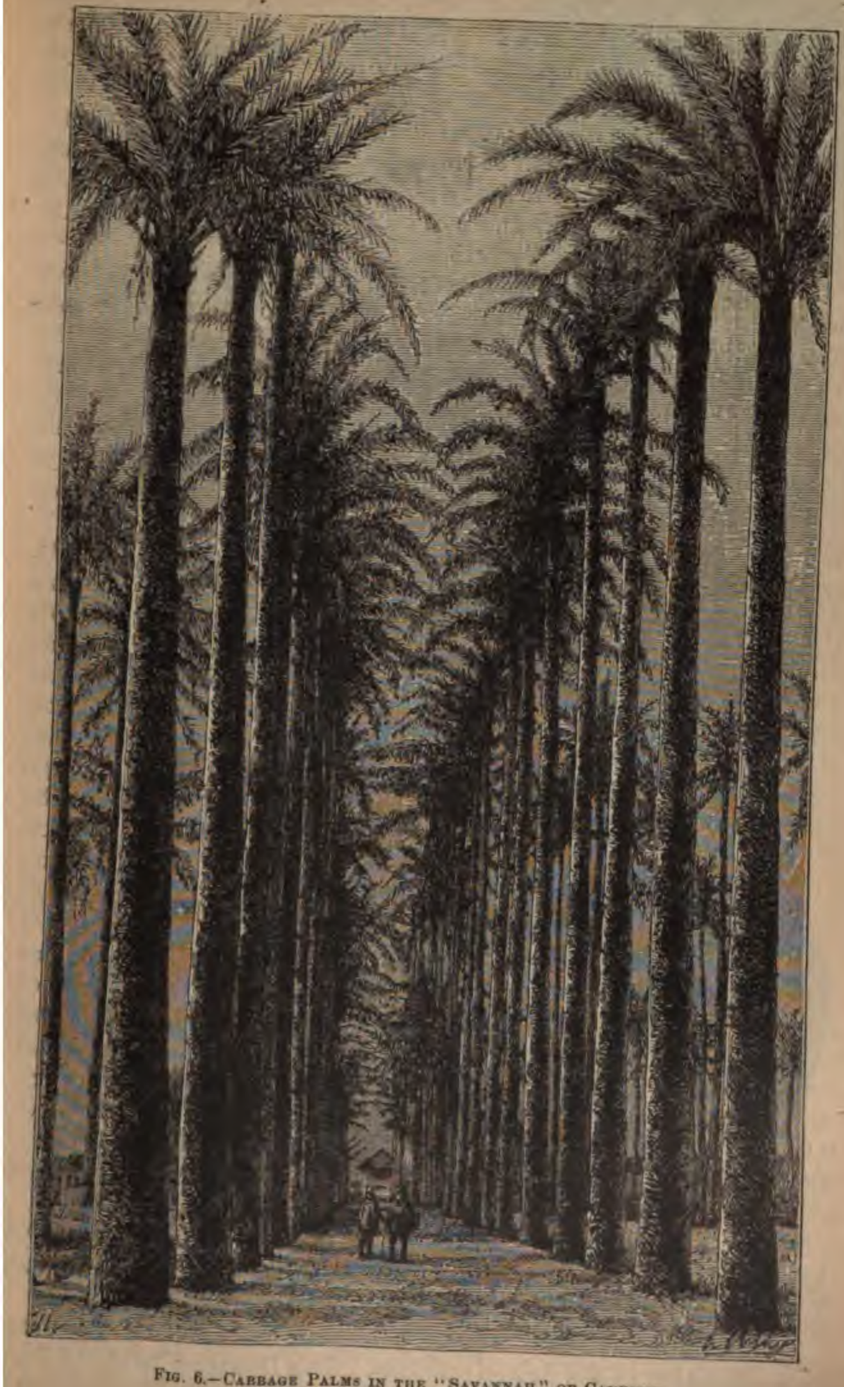


FIG. 6.—CABBAGE PALMS IN THE "SAVANNAH" OF CAYENNE

wanted. The thick, fibrous envelope of the nut has been much used of late years in Europe. After being macerated, the fibers, called *coir* or *cair*, are combed. Ropes made of them are elastic and hardy against decay. They are worked into articles of esparto and brushes, and we tread them under feet in cocoa mattings. From the hard shell of the nut are made cups and dishes, which are susceptible of a ready polish, and can be carved. The leaves can be utilized, like those of other palms, but lack the suppleness of the leaves of other kinds.

Not all the species of *Cocos* bear fruits as large as those of *nucifera*. The small species also contribute to the maintenance of man and industries. A considerable trade is carried on in the little cocoa of Central America (*Cocos lapidea*), which is sometimes called the "convicts' cocoa," because prisoners polish or carve the hard egg-sized shells of the nuts, and make of them balls for mending stockings, bead-boxes, tobacco-boxes, and toys to sell to visitors. The same shell is in favor for making fancy buttons.

Some other species of palm bear eatable or oleaginous fruits. The reddish-yellow, acorn-shaped fruits of the *Paripon* of Guiana (*Guilielma speciosa*) is highly esteemed. It is cultivated under different names in all the Central American countries. Beverages, and often alcohol, are obtained from the fruits of several other species. The *Avoira*, or oil palm, of Africa (*Elæis guineensis*) is, after the cocoa, the most important of the palms as a commercial object. The numerous fruit-clusters of this palm, twice as large as a man's head, contain many fruits of the size of a walnut, the external envelope of which is charged with "palm-oil," a fat that is much used in soap-making, and is esteemed by Africans as an aliment. The kernel of the fruit affords an oil superior in limpidity and savor to that of the pericarp. The African product of avoira fruits is estimated at one hundred thousand tons a year.

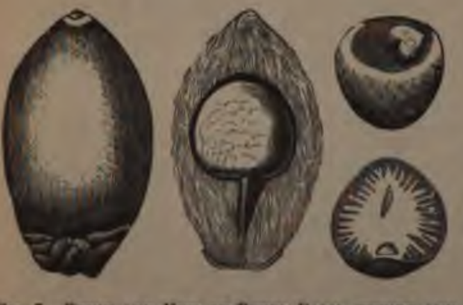


FIG. 7.—FRUIT AND NUT OF BETEL PALM, ENTIRE AND IN SECTION.

The manufacture of textile fabrics from palm-leaves has not been fully experimented upon. A few Central American palms and the oil-palm afford a strong and very fine fiber.

Horticulturists have made much of palm-trees, and they are now abundant in the flower markets. The Bourbon palm (*Livistonia sinensis*); date palms of several species; dwarf palms and the tall *Chamærops*; the *Corypha*; Weddell's cocoa, and two or three other species, are common as room ornaments. Other species do not bear the close air of apartments well, and are very liable to die if taken from the greenhouse or conservatory.

Fig. 6 represents an avenue called the "Savannah of Cayenne," which is composed of the straight-stemmed cabbage palm (*Oreodoxa oleracea* of the Antilles), and has been much admired by travelers. Whenever one of the trees is blown down, or removed by any other cause, another one is at once planted in its place.

Palm-trees rarely grow in numbers together. There are, however, groves of a few species. The *Attalea excelsa* of America, which grows to the height of more than fifty feet, forms small woods. The *Oreodoxa oleracea*, or cabbage palm, is one of the largest species known, with its head often rising above the foliage of the virgin forest. Specimens of it have been found by measure to be about a hundred feet high, and the royal species of Havana rises to nearly one hundred and twenty feet. These plants are for the most part evergreen. They do not love climates of intermittent temperatures and abrupt changes, except in rare cases, of which the *Areca* palm of India (*Areca catechu*) affords an example. This species is extensively cultivated in the Indies, where the firm and astringent kernel of its nut (Fig. 7) is chewed with the betel-leaf by every native, as other people smoke or chew tobacco.

A considerable number of fossil palms have been found, chiefly in the Miocene Tertiary of America, India, and Europe.—*Translated for the Popular Science Monthly from La Nature.*

A HARVEST FROM THE OCEAN.

By Prof. C. MORTON STRAHAN.

THE compensations of nature are nowhere more forcibly illustrated than along the bleak and rugged coasts of Scotland, Ireland, and Brittany, and their adjoining islands. Towering cliffs, whose scarred faces show no sign of verdure and defy all hope of cultivation, clasp the deeply indented bays in rude embrace. Hamlets by the score hide themselves in the more sheltered nooks, and the inhabitants find a precarious living by following the sea. Amid such unpromising surroundings Nature yearly plants and nourishes beneath the waves and along the wave-washed rocks a bounteous crop of sea-weed, which proves a genuine blessing to the dwellers on those shores. Not only is this both planted and nourished by the ocean, but it is to a great degree harvested by the same hand, and laid ready for use at the very doors of the fisherman's hut. The terrible storms which drive the venturous seaman against hidden rocks, sweeping ashore his lifeless body and dismembered ship, also tear up great quantities of this valuable weed from the ocean's bed and dash them in continuous bulwarks high up on the beach. Thus thrown ashore during the winter and early spring is a mass of what the natives call "deep-sea tangle," but which in the hands of the naturalist is recognized as a mixture of two kinds of *Algæ*, termed respectively *Laminaria digitata* and *Laminaria saccharina*. In the spring and fall the milder storms add the "tangle-top" to the winter harvest. The tangle-top, as its name implies, consists of the tops or fronds of the same plants whose stems compose the "tangle" proper. These self-gathered masses constitute the greater bulk and the more valuable part of the annual yield. Together they are known as "drift-weed," as opposed to three varieties of *Fuci* (more commonly known as wracks) which grow on the rocks in that area covered by the rise and fall of the tides, and which, from the manner of their gathering, take the name of "cut-weed."

Recourse must be had at this point to chemical analysis to reveal some useful ingredient which may justify this wet, salty, ill-odored mass of vegetable matter being dignified by the name of a crop. The analyses of the several species of *Laminaria* and *Fuci* show considerable variations; it may, however, be taken that of the ordinary mixed mass of wet tangle and cut-weed about eighty per cent is water, fifteen per cent organic matter, and five per cent ash or mineral matter. In the same way it may be admitted that one hundred pounds of the ash will contain, approximately, twenty pounds of insoluble material, fifty pounds of alkaline carbonates and chlorides, twenty-two pounds of potash and soda, 6·5 pounds of sulphuric acid in combination, and 1·5 pound of iodine in combination as iodides of potassium, sodium, etc. One hundred and fifty years ago such an analysis had never been made, nor would it have possessed any of its present suggestiveness, for at that time iodine had not yet been discovered, and the burning of sea-weed for its ashes was practiced to but a very limited extent. It required the pressure placed upon the soap-makers of France and England by the wars of the great Napoleon to force practical and wide-spread attention to the ashes of sea-weed. In virtue of that pressure the foreign supply of soda and potash salts in both of those countries was entirely cut off, and every domestic substance was ransacked for its contents of alkalies. This gave rise to that general movement among the Scotch and Irish peasantry which resulted in the annual burning of the sea-weed harvest, and the introduction of a new commercial body under the name of varec or kelp.

Though the absolute yield of the alkali salts was small fifty pounds to one ton of the wet weed), so complete was the embargo against Spanish barilla and salt that kelp assumed a value as high as one hundred dollars per ton. During this halcyon period Scotland and her western isles reaped an annual income of nearly three million dollars, a sum which raised to affluence many a Scottish lord whose sole possession hitherto had been a long title and a few miles of barren sea-shore. But the end of the war, and the success of Le Blanc's process for making sodium carbonate out of common salt, brought down the value of kelp with a sudden and disastrous drop. In 1831 the price had fallen to ten dollars per ton, a figure no longer remunerative. At this period kelp-making would have died out entirely but for the presence in it of a small quantity of iodine. The discovery of that element in 1812, by Courtois, and the demands for its manufacture, which had arisen between that date and 1840, were the sole cause for the continuance of kelp-making; for kelp was then, and has since remained, the only practicable source of iodine in Europe. During the past fifty years kelp has furnished fully ninety per cent of all the iodine and iodides which commerce has handled. The remaining ten per cent comes from South America, being derived from the well-known *caliche* of Peru. This substance, in being worked for the large amount of nitrate of soda it contains, also gives a small quantity of iodine as a profitable by-product. The *caliche* yields from two to three pounds of iodine per ton, against an average yield of twelve or fifteen pounds on the part of kelp. Many bothering questions of manipulation increase the labor and cost of the product from the former source, thus leaving the commercial advantage with kelp. With the origin of this new demand for kelp the industry received a strong impulse, and the price was restored to fairly profitable figures, ranging from fifteen to twenty dollars per ton, at which price it is still in commerce.

It may be proper to note several interesting facts connected with the growth and composition of iodine-bearing weeds. All sea-weeds do not contain iodine, although that substance is universally present in sea-water in the ratio of one to two hundred and fifty thousand, proportions which, though minute, are amply sufficient to tempt assimilation by all growing sea-plants at least to an appreciable extent. Yet very few of them outside the family of *Algæ* contain even a trace of that element. So that to this family has been committed the chief work of withdrawing iodine from sea-water, and of concentrating it in plant-tissues in a form easy of extraction. The power of iodine absorption on the part of the *Algæ* is the more remarkable when it is remembered that their growth transpires in the presence of three hundred times as much of the very similar element bromine, which latter, however, is absorbed in [illegible] tenth the quantity. The localities where they grow, as well as the number of iodine-bearing plants, are very limited. The shores of the British Isles and of Brittany are the spots most favored, owing to the presence of the Gulf Stream, which serves as the carrier of the iodine and of the temperature conditions necessary to the growth of the *Algæ*.

By far the larger portion of the sea-weed harvest comes ashore in the early spring and in the late fall. The fall harvest, together with that which winter adds, is suffered in most localities to lie untouched on the beach until it has been carried out to sea again and lost forever. It is only the spring crop which receives special care. Thousands of women and children, and a small sprinkling of men, may be seen flocking to the beach during the month of May, armed with rakes and wheelbarrows, or driving low carts, whose wheels are made broad enough to prevent their sinking in the sand. The wet weeds are raked into piles, and carried either by barrow or cart to a conveniently safe distance from the water's edge. Usually a sheltered nook is chosen, if near at hand, and in it is stored a great mass of the weed. Here it is left to dry under the summer's hot sun, meanwhile exhaling odors of no dainty description. There are well-recognized liberties and restrictions in regard to sea-weed accorded to landlords and peasantry who dwell along the shore. The landlords have most of the liberties, while the peasants enjoy the restrictions. Conflicts of sea-weed rights have been known to occur, in which cases the shillalah has had an important share in the gathering of the crop.

When the weed is dry—that is, in the latter part of July and the first of August—the owners of the sea-weed heaps undertake to burn them into kelp. This burning is done in the crudest and most wasteful manner. Shallow pits, often dug right in the sand, are filled with weed and the mass ignited. Upon the first charge fresh quantities of weed are thrown from time to time, the whole mass burning more or less rapidly in proportion to the dryness of the weed. There results, in the bottoms of these pits, a black mass resembling iron-slag in appearance, though not in hardness, which, being sprinkled with water while hot, breaks up into large lumps suitable for transportation. Owing to the carelessness with which the weeds are raked up, this crude kelp-slag always contains a large percentage of sand and other impurities, sometimes amounting to one half the total weight of the product. The improvidence of this is the more marked in view of the small amount of valuable salts which even at best can be found in the kelp, and the rapid ratio in which the cost of transportation diminishes the profits when half of the slag is dead weight. The improvidence extends equally to the burning itself. This takes place in full access of air, and at a temperature so high as to volatilize much of the iodine. Besides, all the gaseous products of the combustion are lost and the escaped gases overcloud whole townships, and impart to miles of sea-shore the peculiar odor characteristic of burning kelp. To save these gaseous products by distilling the weeds in closed retorts, at low temperatures, would mean the production, at little extra cost, of valuable amounts of ammonia, parafin, acetic acid, naphtha, etc. In addition, the charcoal left would be much richer in iodine than the ordinary kelp, and its mechanical form much easier of subsequent extraction. Attention has been called time and again to the enormous waste of material and the easy means of improvement in kelp-making, but thus far little inroad has been made into this European species of ancestor-worship. The crofters cling to traditional methods and primitive tools.

When kelp, such as has been described, is brought into market, it is purchased by those directly engaged in making the salts of iodine and the alkalies. In their hands it becomes the subject of careful treatment to separate the valuable ingredients from the gross impurities with which they are associated. This is commonly done by breaking the kelp into small lumps and lixiviating in suitable vats filled with hot water or supplied with steam vapor. Such treatment, when sufficiently prolonged, dissolves out the alkaline and iodine salts, which need only the subsequent operation of being allowed to settle and siphoning off to separate them from the insoluble matters. The liquor contains chiefly the chlorides, the sulphates, the sulphites, and the hyposulphites of sodium and potassium, as well as the iodides and bromides of those metals. By evaporating this solution, the greater portion of the chlorides and sulphates will crystallize out before the iodides, bromides, and lower sulphur compounds begin to deposit. The former may then be fished out of the evaporating pan, leaving a resultant mother-liquor rich in iodides. The hurtful sulphur compounds remaining are decomposed by excess of strong sulphuric acid, and then the proper quantity of manganese dioxide is added. This mixture is transferred to an iron retort and heated, the result of which is to liberate the iodine and part of the bromine present. The vapors of these elements are conducted into proper earthenware condensers, where the iodine is deposited as a black powder, and the small quantity of bromine as a dense brown liquid moistening the iodine powder. As before indicated, from twelve to twenty pounds of this crude iodine are obtained from the mother-liquor of one ton of kelp. There are several possible ways of purifying the crude iodine, in order to secure the iodine of commerce and also the bromine which had been its chief impurity. Even this purified iodine contains minute traces of bromine, owing to the difficulty of their perfect separation. If iodide of potassium is desired instead of free iodine, it is still necessary to produce the latter, and from it obtain the iodide by the action of potassium hydrate or caustic potash.

Iodine, as a commercial body, has been subject to great fluctuations in price. It has ranged from a minimum of $1.50 to a maximum of $9.50 per pound, and is at present quoted at the fairly constant figure of $4 per pound.

This harvest of sea-weed, whose transformation into iodine has been briefly traced, has been to a certain extent the subject of other industrial applications. In Ireland and the Channel Islands the weeds are used directly as a fertilizer. Its advantages in this line are chiefly felt in the Irish potato crop, where the potash of the sea-weed supplies a most important ingredient of that staple tuber. The presence, also, of small proportions of the earthy phosphates increases its value for fertilizing purposes. Attempts have been made to utilize these weeds in the manufacture of paper and textile goods, but with little or no success, owing to the fact that the true *Algæ* are not fibrous in their structure; nor is it surprising to find sea-weed quite extensively used as a fuel among a tenantry so poverty-stricken, and in a country so bare of combustibles. But the chief value of the sea-weed harvest remains in the monopoly of iodine which its tissues possess.

Despite its many wasteful drawbacks, the kelp industry shows the respectable annual yield of six million dollars, much of which finds its way into the pockets of a very destitute tenantry. In those districts where the winter supply is carefully gathered and burned, the production of kelp has had very beneficial effects by employing and remunerating the most indigent classes at a time when they would otherwise be totally unproductive.

BIRDS WITH TEETH.

By OTTO MEYER, Ph. D.

THE birds of our present world, however different they may be from each other in size, shape, color, etc., are remarkably uniform in their anatomical construction. Adapted to a life in the air, they all possess bones which are more or less pneumatic—that is, contain air-cavities, to lessen the weight of the skeleton. Altogether the reduction of weight has been brought down to perfection, and a flying bird carries very little, if any, unnecessary substance. Locomotion in the air requires, further, a vigorous action of the wings, and such a motion could hardly be executed in presence of a loose and shaky body. But the skeleton of the body of a bird is not loose; on the contrary, it is very solid. The vertebræ of the backbone are grown together and form a firm column. With this column the broad ribs unite in the back, while in front they are held together by the sternum; and to make this cradle of bones more compact and fit to resist the action of the wings, and to protect the interior organs, the ribs touch each other with what the anatomists call "uncinate processes." Whoever is called upon to carve at the table a chicken or a turkey will experience how solid and protective the construction of the skeleton of the body is.

If the main body is in this way compact and immovable, some other part must be so much the more flexible, and this is the neck. If we watch a swan oiling its feathers with its bill, see the cervical evolutions of a flamingo, or an owl sitting with its head reversed, we are apt to experience a painful sensation in our necks and may wonder whether the bird will assume its normal position without breaking something. But all these motions are executed with the most perfect ease and security, and the construction of the vertebræ, which enables the birds to perform them, is simple and effective. These vertebræ do not articulate with each other by plain faces as the vertebræ in our bodies, but the articulations are saddle-shaped, so that the prominence of one vertebra fits into the excavation of the next one, and *vice versa*. If we take two adjoining vertebræ of the neck of a bird and try their motion, we shall find that this articulation admits two ways of turning—from one side to the other as well as up and down. This saddle shape of the articular face of the cervical vertebræ is found without exception in all existing birds and in no other animal.

There are other features which are met with in all birds and exclusively in them—for instance, the plumage. The horny bill is without teeth. The vertebræ of the tail are grown together and form a plowshare-shaped bone. This bone supports the tail feathers, which can be opened and closed like a fan, and which serve as a rudder and a parachute. The bones of the anterior extremities are transformed in such a way that they form an excellent framework for the wings; but, although the anatomists distinguish easily radius, ulna, digits, etc., one would hardly suspect that these wing bones are perfectly analogous to those in the fore-feet of quadrupeds, or in our arms and hands.

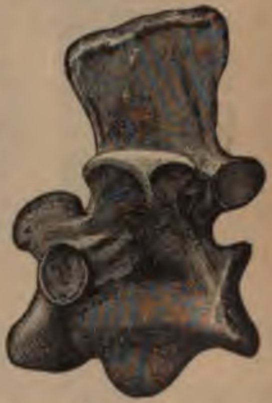


FIG. 1.—VERTEBRA OF A BIRD WITH SADDLE-SHAPED ARTICULAR FACE.

Now let us turn our attention to the reptiles which exist at the present time—to the lizards, crocodiles, snakes, and turtles. These cold-blooded, scaly animals seem to have nothing at all in common with the warm-blooded, feathered inhabitants of the air; and yet our first scientists, for instance, Prof. Huxley, unite reptiles and birds as one class of animals. However closely we may study the anatomy of a chicken and of a crocodile, and search for points which are common to both, we shall be only moderately inclined to follow the example of these naturalists and consider birds and reptiles as near relatives. But we shall become convinced of their close connection if we study also their geological history.

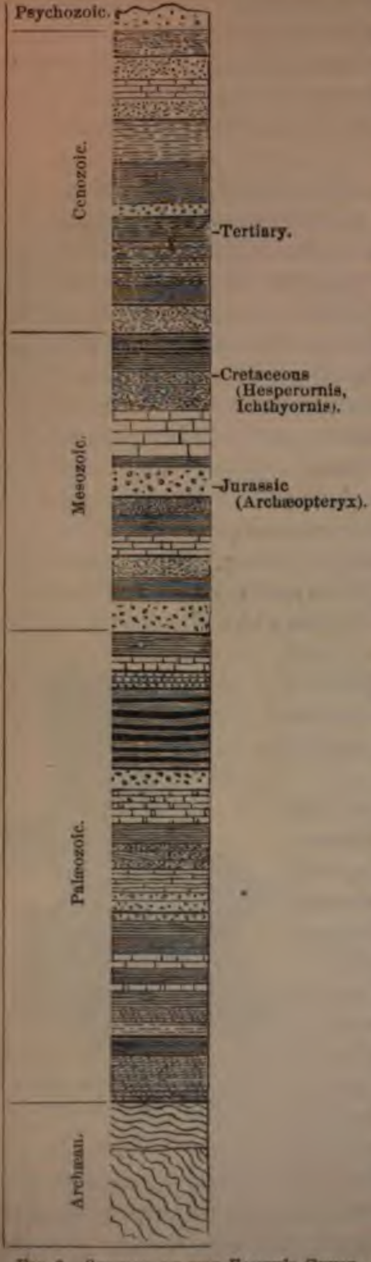

Psychozoic.
Cenozoic.
Mesozoic.
Palæozoic.
Archæan.
-Tertiary.
-Cretaceous (Hesperornis, Ichthyornis).
-Jurassic (Archæopteryx).

FIG. 2.—SECTION OF THE EARTH'S CRUST.

In the first instance, we then see that the reptiles of the present time are only small remnants of a once numerous and powerful tribe. In certain former geological periods we find reptiles to be the kings of the earth; we discover reptiles of enormous sizes; reptiles of all kinds of shape and anatomical construction; and among them there are some which resemble birds much more than does a crocodile or a lizard of the present day. In the second instance, if we look at the birds of former periods we find that, in the same way as we go backward in the history of our earth, these former inhabitants of the air differ more and more from the specialized pattern after which all our present birds are built, that they become more and more reptile-like, and that there can hardly be any doubt that the birds are indeed branched off from the great reptilian trunk of the animal kingdom.

There are three fossil birds of pretertiary age known almost completely; two of them were found in the Cretaceous formation of North America, and one in the Jurassic formation of Germany.

During the Cretaceous period the Rocky Mountains were not yet the high elevation which they are now, but were existing probably only as a succession of low islands. The land of several States of the Union was deposited at that time at the bottom of the ocean, east of this line of islands. One of these States is Kansas, in which, therefore, the cold water was then still more supreme than it is now. In the Cretaceous deposits of Kansas the remains of the bird *Hesperornis* have been found. It was a large animal, about five feet long, with well-developed, strong legs, but perfectly obsolete wings. The anatomical construction indicates the way of living. It was entirely without the power of flight, living in the way of penguins, mostly on the water, diving for fish, which it was admirably adapted to catch, and with which the Cretaceous ocean here was teeming. The shores were visited probably only for the purpose of breeding. There is nothing very peculiar in its anatomy, with the exception of one fact, which, however, distinguishes it at once thoroughly from all birds living now; its long bill was provided with teeth, teeth which resemble those of reptiles. Few discoveries have at their time caused so much [illegible] among geologists as when through

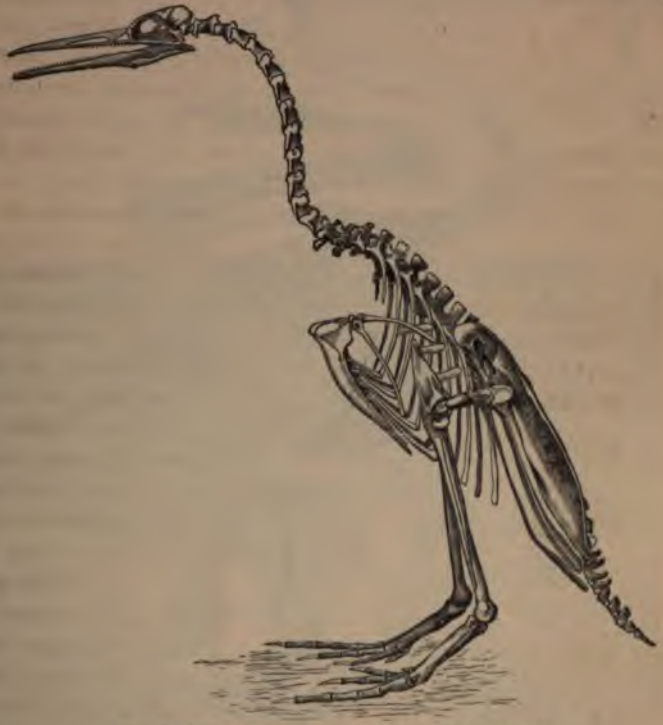


FIG. 3.—HESPERORNIS REGALIS (restored by Marsh).

Kansas fossils the fact was established that birds with teeth formerly existed.

The deposits of Kansas in which the *Hesperornis* has been found have yielded also the remains of another Cretaceous bird, the *Ichthyornis*. This animal was small, of about the size of the tern, and probably also resembled it in its habits and mode of living; at any rate, it was a good flier, with powerful wings and small legs. The *Ichthyornis* also had teeth in both jaws. But in still another respect it was different from all our present birds. The articular faces of its vertebræ were not saddle-shaped, but simply excavated on both sides; they were biconcave. This form of vertebræ is met with in a few recent and many extinct reptiles, and in the amphibians. But it is especially characteristic of fishes, and the name has been chosen on account of it, for *Ichthy-*

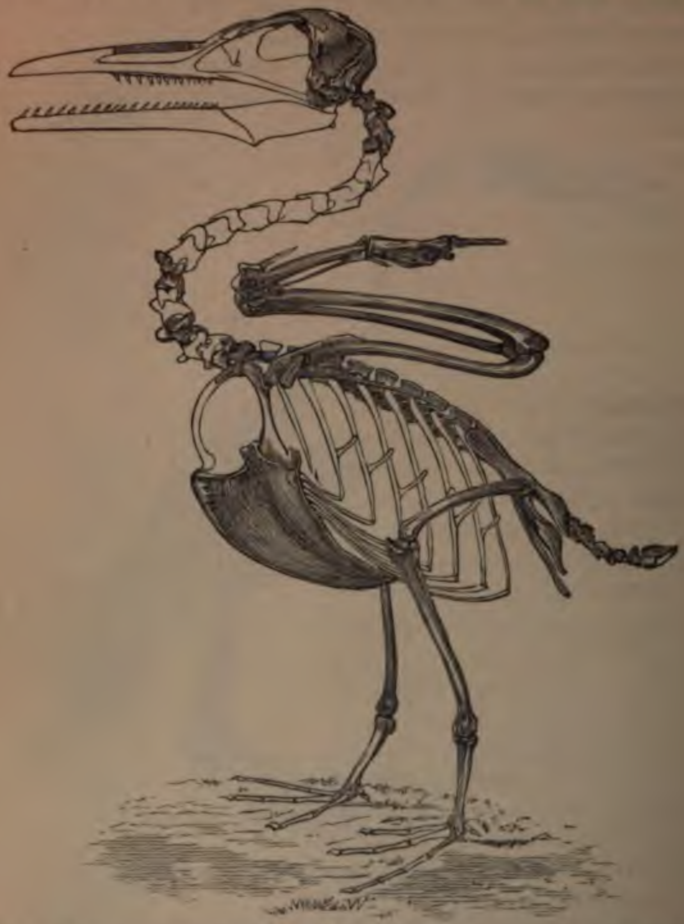


Fig. 4.—Restoration of Ichthyornis victor (after Marsh). One half natural size.

ornis means "fish-bird." The fossil remains from which *Hesperornis* and *Ichthyornis* have been described are exhibited in the Museum of Yale College, in New Haven.

A long time, a whole geological period, before *Hesperornis* and *Ichthyornis* were enjoying life and eating fish on the vast Cretaceous ocean of the western United States, there was on the other side of the Atlantic, at about the site of the town of Solenhofen, in Bavaria, a lake or marine gulf in a protected situation, with very quiet waters. The lime carried by the rivers into this gulf was deposited at the bottom, in an exceedingly uniform and undisturbed manner, as a very fine sediment. At present, after millions of years, the gulf is dried up and the sediment has been hardened to a limestone, the grain of which is unusually small and regular. In fact, no limestone in any country

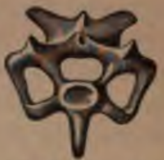


Fig. 5.—Cervical Vertebra of Ichthyornis dispar, × 2.

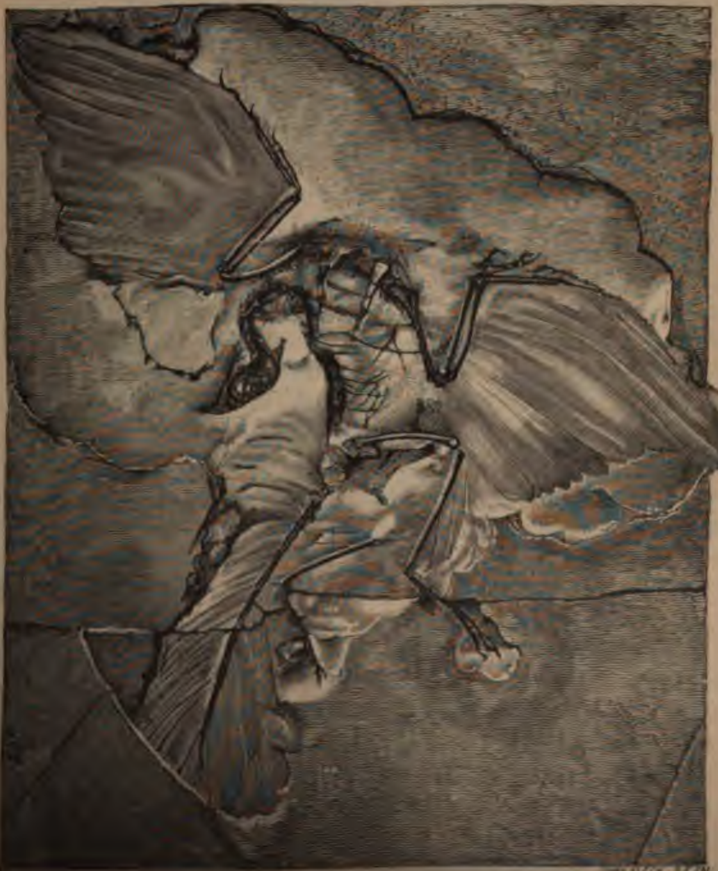


Fig. 6.—Archæopteryx macroura (Berlin specimen).

surpasses, or even equals, this Jurassic limestone of Bavaria in this respect, and therefore the lithographers of the whole earth receive their lithographic stones from the quarries of Solenhofen. We may obtain an idea of the exceptional and uniform way in which this limestone has been deposited when we see the impressions and casts of jelly-fish and other delicate animals, which are found as fossils in this stone and in no other known deposit.

In this lithographic stone of Bavaria there was found, in the year 1860, the impression of a feather. This proved the existence of a bird during the Jurassic period—that is, of a feathered animal much older than all other known fossil birds. It was therefore named *Archæopteryx*, which means "old wing." The feather was there; a sharp lookout was kept now for the bird itself, and, indeed, one year later, a nearly complete skeleton of it was found. It was bought by the British Museum, in London, for fourteen thousand marks, and has been described by Prof. Owen. Sixteen years later, in 1877, a second specimen was discovered in Solenhofen. The electrician, Dr. Siemens, in Berlin, did not wish that this fossil should also go out of Germany; therefore he bought it for twenty thousand marks, and sold it afterward, at the same price, to the Prussian Government. It is now in the Berlin Museum.

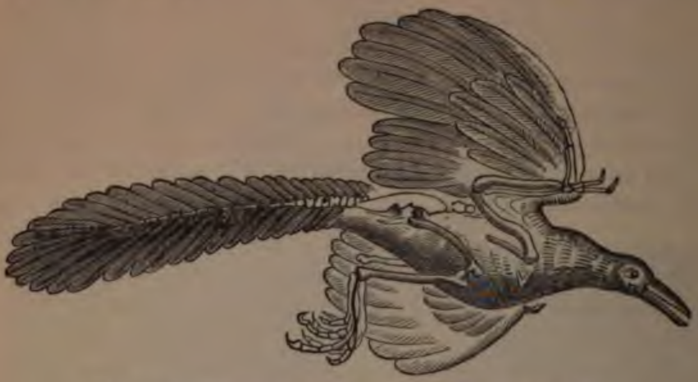


FIG. 7.—ARCHÆOPTERYX MACROURA, RESTORED (after Owen).

Both specimens together furnish us with an almost complete picture of the Jurassic bird. The *Archæopteryx* was about the size of a pigeon. The Berlin specimen proves that its bill was also provided with teeth. Furthermore, the vertebræ show also that biconcave form, as in *Ichthyornis* and in lower animals. But there are a number of other features in the *Archæopteryx* which remove it still further from the birds of the present time, and make it resemble a reptile: 1. Its wing bones were not grown together in the way of all the other birds, but they were partially separate, as in the fore-foot of a quadruped, and there were even three claws, so that the animal could also grasp with its wings. 2. Its ribs were small, thin, without uncinate processes, and therefore formed no compact and solid cradle. 3. Its pelvic bones were almost like those of certain extinct reptiles. 4. Its tail was not short, with a plowshare-shaped bone and a fan-like arrangement of the tail feathers, as in all other birds, but it was long, composed of not less than twenty vertebræ, and the feathers were fixed along the whole length of this tail. In other words, it was a regular lizard tail, but covered with feathers. It is no wonder that some scientists did not consider the *Archæopteryx* as belonging to the birds, but thought it was a reptile. Apart from its plumage, however, there is too much in its anatomy that is avian. At any rate, it was a very reptile-like bird, and its power of flight was certainly not great. It probably fluttered more than flew, and occasionally used its claws to support itself. The formation of its eye bones seems to indicate that it was of nocturnal habits, like our owls.

Other fossils, lying as yet unknown in the strata of our earth and waiting for the ardent scientific digger, will teach us considerably more about the evolution of the birds, but the outlines of it are already mapped out by what we possess at present; and it must be said, especially about the *Archæopteryx*, that it sheds more light upon the development of the animal kingdom during former periods than perhaps any other known fossil.

THE EFFECT OF CAVE LIFE ON ANIMALS, AND ITS BEARING ON THE EVOLUTION THEORY.

BY A. S. PACKARD.

THE main interest in studies on cave life centers in the obvious bearing of the facts upon the theory of descent. The conditions of existence in caverns, subterranean streams, and deep wells are so marked and unlike those which environ the great majority of organisms, that their effects on the animals which have been able to adapt themselves to such conditions at once arrest the attention of the observer. To such facts as are afforded by cave life, as well as parasitism, the philosophic biologist naturally first turns for the basis of his inductions and deductions as to the use and disuse of organs in inducing their atrophy. It is comparatively easy to trace the effects of absence of light on animals belonging to genera, families, or orders in which eyes are normally almost universally present. As we have seen in non-cavernicolous animals, the eyes are wanting from causes of the same nature as have induced their absence in true cave animals. No animal or series of generations of animals, wholly or in part, lose the organs of vision unless there is a physical appreciable cause for it. While we may never be able to satisfactorily explain the loss of eyes in certain deep-sea animals from our inability to personally penetrate to the abysses of the sea, we can explore caves at all times of day and night, of winter and summer; we can study the egg-laying habits of the animals, and their embryonic development; we can readily understand how the caves were colonized from the animals living in their vicinity; we can nicely estimate the nature of their food, and its source and amount, as compared with that accessible to out-of-door animals; we can estimate with some approach to exactitude the length of time which has elapsed since the caves were abandoned by the subterranean streams which formed them and became fitted for the abode of animal life. The caves in southern Europe have been explored by more numerous observers than those of this country, and the European cave fauna is richer than the American, but the conditions of European cave life and the effects of absence of light and the geological age of the cave fauna are like those of American caves. Moreover, the cave life of New Zealand and the forms there living in subterranean passages and in wells show that animal life in that region of the earth has been affected in the same manner. The facts seem to point to the origin of the cave forms from the species now constituting a portion of the present Quaternary fauna; hence they are of very recent origin.

The result of cave exploration shows that no plants, even the lowest fungi, with the exception of *Oozonium auricomum* Link, and perhaps one or two other kinds of fungi common to Europe and America in and out of caves, can so adapt themselves as to live and propagate their species in the total darkness of caverns. They are far more dependent on the influence of light than animals.

We will now briefly rehearse the facts relating to the changes in structure and color undergone by animals adapted to a life in total darkness in caves, premising that, so far as we know, the Protozoa detected in subterranean waters do not essentially differ from those living in the light. It appears from the following facts that eyeless animals change their color as well as those having eyes:

1. A sponge (*Spongilla stygia*) found by Dr. Joseph in the waters of Carniolan grottoes, instead of being green, is pellucid and bleached.

2. The Hydra (*H. pellucida*), also found by Dr. Joseph in the subterranean lakes of Carniola, was, as its name indicates, neither

green nor brown, like the two species of the upper world, but pellucid, bleached out, or colorless.

Such was also found by Dr. Joseph to be the case with the smaller crustaceans, such as certain cave species of Cypris, Leptodera, Estheria, and Branchipus (*B. pellucidus* Jos.).

3. As regards change of color, we do not recall an exception to the general law that all cave animals are either colorless or nearly white, or, as in the case of *Arachnida* and insects, much paler than their out-of-door relatives.

The worms (planarians and earth-worms) are somewhat paler than their allies living out of caves, but as the normal environment of most planarians and earth-worms is much like those of cave animals, the difference is not so marked, though both of our cave planarian worms are white and eyeless.

All the cave *Crustacea*, both aquatic and terrestrial, are colorless or whitish, more or less vitreous, and pellucid, the pigment cells being degenerate and functionless. The effects of total darkness seem quite different from the influence to which the eyeless deep-sea *Crustacea* are exposed, since they, like their fellows with eyes normal or hypertrophied, are said to be of the same flesh and reddish tints common to deep-sea animals.

In the case of the cavernicolous myriapods the bleaching of the body is very marked. In out-of-door myriapods the normal tint of the integument is brown or rarely amber-brown; but the color of the cavernicolous species is white or flesh-white, like a freshly molted myriapod of normal habitat.

The cave species of *Arachnida* are usually whitish or pale amber-colored, or pale horn, with a reddish tint. Of the mites, some are white, others horn-color, or chitinous. In the family *Chernetidæ* the cave species are "dull white," or "pale horn with a reddish tint," or "pale yellowish."

The effects upon the eyes and optic lobes of a life in total darkness are the following:

1. Total atrophy of optic lobes and optic nerves, with or without the persistence in part of the pigment or retina and the crystalline lens (*Cæcidotæa, Crangonyx, Chthonius, Adelops, Pseudotremia*).

2. Persistence of the optic lobes and optic nerves, but total atrophy of the rods and cones, retina (pigment) and facets (*Orconectes*).

3. Total atrophy of the optic lobes, optic nerves, and all the optic elements, including rods and cones, retina (pigment) and facets (*Anophthalmus, Scoterpes*, and ? *Anthrobia*).

An interesting fact confirmatory of the theory of occasional rapid evolution, as opposed to invariably slow action involved in pure Darwinism, is that we never find any rudiments of the optic lobes or optic nerves; if they are wanting at all, they are totally abolished; there is not a series of individuals with these organs in different degrees of development corresponding to the rudimentary conditions of the eye. The atrophy is comparatively rapid, sudden, and wholesale. On the other hand, we have series, as in *Cæcidotæa* or *Chthonius*, where there is but a single, or two or three, or several crystalline lenses, partially enveloped in pigment.

These varying degrees of development in the peripheral parts of the eye prove that the animals entered the caves at different periods, and have been exposed for different lengths of time to the loss of light. For example, those individuals of *Chthonius Packardii* which live in the Labyrinth of Mammoth Cave are eyeless, or have merely pigment spots; those collected in the Rotunda (which is much nearer the entrance to the cave) have eyes, or at least lenses and a retina. While most individuals of the *Cæcidotæa* are eyeless, a few have rudimentary eyes. Thus, in the differing conditions of the eyes in different individuals, we have an epitome of the developmental history of the genus *Cæcidotæa* and its species. Certain *Aselli* borne into caves or introduced into subterranean streams feeding deep, dark wells, losing the stimulus of the light, begin to lose their eyes and the power of sight. The first step is the decrease in the number of facets and corresponding lenses and retina; after a few generations—perhaps in four or five—the facets become reduced to only four or five; the eye is then useless; then all at once, perhaps after only two or three generations, as a result of disuse, there is a failure in forming images on the retina, and those complicated, elaborate structures, the optic ganglion and optic nerve, suddenly break down and are absorbed, though the external eye still exists in a rudimentary state. These imperfect lenses and retinæ, like all rudimentary organs throughout the animal world, are like ancient, decayed sign-posts, pointing out some nearly obliterated path now unworn and disused. The result of change of environment, with disuse and atrophy of the organs of vision, together with the inheritance of these defects and their establishment as fixed specific and even generic characters, results in the creation of a new natural genus with its assemblage of species, and, if we include all the cave animals thus produced, the creation of a new fauna. It would be a thorough test of the theory of descent if we could keep these creatures in confinement, exposed first to twilight and then to the full light of day, and endeavor to breed a few generations of these blind animals and ascertain whether their descendants would not revert to the original ancestral eyed forms. The *Cæcidotæa* would perhaps be the best subject for such an experiment; it is so abundant and easy to breed. That the *Cæcidotæa* has been evolved from some species of *Asellus* hardly admits of a doubt. Our *Asellus communis* abounds under sticks and stones, submerged boards and logs, throughout the Northern and central States. Thence it could readily be carried, in cavernous regions like those of southern Illinois, Indiana, and Kentucky, into subterranean streams. The supply must be very great, as the individuals of *C. stygia* are very abundant; indeed, so far as we know, as much as or even more so than those of *Asellus communis.*

In the blind crayfish of the caverns of Indiana and Kentucky, and of the similar species (*C. hamulatus*) inhabiting the Nickajack Cave of Tennessee, we have two aberrant forms belonging to a widely diffused group, whose center of distribution lies in the Mississippi Valley, and which is rich in species and in individuals. All the streams and ditches situated over or near the caves are densely populated with crayfish. I was interested, after finding *C. pellucidus* in a stream flowing through the Bradford Cave, near New Albany, Indiana, to find the common eyed crayfish of that region in great abundance a few yards from the mouth, outside of the cave, in the shallow brook issuing from the cave itself. That crayfish with eyes can readily enter a cave—probably in time of freshets—is proved by the fact that *Cambarus Bartonii* is often found in Mammoth Cave, where it finds food; and a small specimen has been found by Mr. Putnam a little paler than usual—i. e., as pale as the darker specimens of *C. pellucidus*—but the eyes were normal, though it is doubtful if it lives long enough in the cave to breed there.

The nearest out-of-door ally of *Cambarus pellucidus* is *Cambarus affinis.* On the other hand, the nearest lucicolous ally of *C. hamulatus* is perhaps *C. latimanus.*

It is instructive to find that, in regard to the development of the eyes, and the slenderness, size, and color of the body, these two cave crayfish closely resemble each other, though obviously originating, as Prof. Faxon states, from species belonging to quite different sections of the genus *Cambarus,* and to a different, more southern, river valley. These facts appear to prove beyond question that the cave species of crayfish in the United States have descended from quite different species of *Cambarus,* belonging to different zoögeographical areas. Had the two species of blind crayfish been produced instantaneously by special creation, as popularly supposed and advocated in the past by some naturalists, why should the accessory genital organs (*gonopoda*) differ so much that on this account they belong to different sections of the genus *Cambarus?*

The cave *Phalangidæ,* or harvest-men, whose habits and distribution in Europe as well as the United States, both as regards lucicolous and cavernicolous forms, have been given in much detail elsewhere, illustrate clearly the theory that certain subterranean forms, living deep in the soil, under stones in the cave regions of both hemispheres, especially in France and Austria, have been carried into caves, have survived the loss of out-of-door conditions, becoming adapted to the new and strange environment, losing their eyes totally or in part from disuse of those organs, and have bred true to the new specific characters thus established, and are now as unchangeable as the physical conditions in which they live.

The cave spiders in all important respects exemplify the same rule. They belong to, or are closely allied to, genera rich in species in the cavernous regions they inhabit, and which live in dark places. Although scarcely necessary in its changed environment, where there are no hydrographic changes, no winter and summer, and few enemies to contend with, the most aberrant form, the completely eyeless *Anthrobia* of Mammoth Cave, still spins a silk cocoon around its eggs; while in Weyer's Cave *Nesticus pellidus* Emerton spins a cocoon for its eggs; and either this species or its fellow troglodyte, *Linyphia incerta* Emerton, or both species, spin a weak, irregular web, consisting of a few threads. Is not this a useless habit, a simple survival of ancestral traits?

It was noticed that the number of individuals of different species was greater in the smaller shallower caves, such as the Weyer and Carter Caverns; each of these groups of caves has three species, while in Mammoth Cave there is but one, and the individuals are less common. Moreover, all are darker than *Anthrobia*, all have eyes, and the number of eyes is variable. These facts show that *Anthrobia* and the eyed forms have originated from species living in partial darkness at or near the mouths of the caverns. In Mr. Emerton's description of *Linyphia incerta* it will be seen how variable are the number of eyes. From this it may be inferred that the specific characters of this form, as regards the eyes at least, have not been firmly established, and hence it has only recently become a true troglodyte.

In the foregoing examples we have as yet not discovered in this country any connecting links between the eyed and blind or eyeless species of cave animals. But in a series of specimens of a cave myriapod, *Pseudotremia cavernarum*, which is abundant in the Wyandotte and Carter Caves, we have what we regard as good, if not complete, evidence that this cave form has directly originated from a common and widely distributed out-of-door form. The cave *Pseudotremia* has black eyes, composed of from twelve to fifteen facets arranged in a triangular area; of one hundred and fifty specimens examined none were found to be eyeless. In a large cave like Wyandotte there is little variation in this species as regards size, proportion, or color (being white with a slight flesh tint). But in Bradford Cave, a grotto in Indiana, only three hundred to four hundred yards deep, where the conditions are naturally more variable, the species likewise varied more in proportion of parts, and in respect to the eyes, which were more rudimentary, while the individuals were whiter.

We have attempted to show that the only known species of the myriapod genus *Pseudotremia* has been derived from the widely diffused *Lysiopetalum lactarium* (Say); it differs in having only about half as many segments as in its out-of-door parent form (this diminution in the number of segments being due to arrest of development); in the smaller, rudimentary eyes, while the antennæ are slenderer and longer. Now, in the Carter Caves of eastern Kentucky we found specimens which prove to us that the cave form is only a modified *L. lactarium*. In those caves *Pseudotremia cavernarum* is only partly bleached, being brownish; the eyes are larger, having from twenty-three to twenty-five facets; and the general appearance of the specimens is such, especially the prominent ridges on the latero-dorsal tubercles, that the specimens might be mistaken for pale, partly bleached *L. lactarium;* yet the variety (*Carterensis*) is true to its generic character, having half as many segments as in *Lysiopetalum*. Why the number of body segments should be so greatly diminished in the cave form is only explicable on the ground that it is due to an arrest of development, or that the cave form has descended from some unknown species of *Lysiopetalum*, with half the number of segments as *L. lactarium*.

In like manner the Mammoth Cave hairy myriapod, *Scoterpes Copei*, was evidently derived from some species of the hairy genus *Trichopetalum*. *Scoterpes* has no trace of eyes, and differs from *Trichopetalum* in the longer legs and slightly longer and slenderer antennæ. There is no reasonable doubt but that *Scoterpes* is a bleached *Trichopetalum* which has lost its eyes, and consequently has longer legs. Some systematists may yet refer it to *Trichopetalum*, to which it has the same relations as *Anophthalmus* to *Trechus*. It should be observed that several myriapods found in twilight within the mouths of caves, such as species of *Polydesmus* and *Cambala*, are more or less bleached, showing the change wrought by a life in partial darkness after a limited number of generations.

The *Podurans* afford instances of the modification of color especially. Whether living in caves in the central States or in Utah, the common cosmopolitan *Tomocerus plumbeus* is bleached, retaining its eyes, though they are of diminished size. This is, however, rather a twilight than a true cave species.

The beetles of the genera *Anophthalmus* and *Adelops* are the best-known examples of cave animals. The *Adelops* of Mammoth

Cave and a few adjoining caves—the only species in this country of the genus—is blind, but possesses rudiments of the outer eye, several corneal lenses surviving. On the other hand, the species of this or the closely allied representative genus *Bathyscia*, to which they are now referred by Dr. Horn, are very numerous in Europe, and are scavengers in habit. Bedel, in his list of the cave insects of Europe (1875), states that sixty-five species are known, and that several others were known but not described, and that probably further explorations in the region of the Pyrenees, both in France and Spain, will lead to further discovery of species. It appears that not all the species live in caves, but occur in the open air under large stones, moss, vegetable detritus, or at the entrances to caves. It is apparent, then, that the cave animals are emigrants from out of doors, and that the cave species, by isolation from the light and from interbreeding with out-of-door forms, as well as by adaptation to total darkness, have become fixed species with separate generic characters.

Equally instructive and explanatory of the origin of cave animals in general is the genus *Anophthalmus*. In the caverns of the central United States there are only eight species, and none occur elsewhere in America, though we have two or three species of *Trechus*, one at least not infrequent, and *Trechus micans* is common to both hemispheres. Not alone loss of sight and eyes, but other modifications of the body, legs, and antennæ, evidently the result of loss of sight, occur, so universal is the modification of the organism. It is evident that southern Europe is the zoögeographical center of this subgenus, for sixty-four species of completely eyeless beetles referred to this genus have already been discovered in the caves of Austria, Italy, France, and Spain. Lately, however, owing to the studies of Putzeys, and especially of De Perrin, the genus *Anophthalmus* has been united to *Trechus*, since there is a series of forms with more or less rudimentary eyes connected with the eyed species of *Trechus*. Bedel also tells us that in all the species of *Trechus* there is a natural tendency to penetrate into grottoes, even when ordinarily they live in the open air buried in the earth under stones.

It seems reasonable to conclude that the cave species, which are without optic ganglia, optic nerves, and any traces of eyes, had originally, by adaptation to total darkness, become isolated, and that their characteristics after being fixed by heredity have been transmitted for generations, becoming as unchanging in their way as the physical conditions of darkness and uniform temperature surrounding them. Those living in the open air in the soil under stones, or at or just within the entrances to caves, vary most as regards the eyes, as we have found to be the case with the other forms previously mentioned.

This intimate dependence on the physical conditions of life is so plainly shown in these animals, that we can well understand how potent have been the factors (i. e., change from light to total darkness and an even cave temperature) which have operated on out-of-door forms to induce variation. Given great changes in the physical surroundings, inducing loss of eyes from disuse, the abolition in some cases of the optic ganglia and optic nerves, the elongation of the appendages, isolation from out-of-door allies, and the transmission by heredity owing to close in-and-in breeding within the narrow fixed limits of the cave, and are not these collectively *veræ causæ ;* do they not fully account for the original variations and their fixation; in short, can we not clearly understand the mode of origin of cave species and genera? What room is there in a case like this or in that of parasitic animals for the operation of natural selection? The latter principle only plays, it has seemed to us, a very subordinate and final part in the set of causes inducing the origin of these forms.

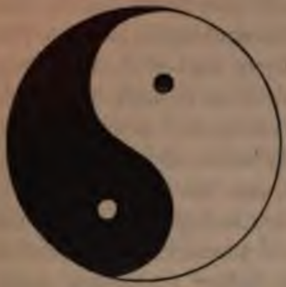
THE CHINESE THEORY OF EVOLUTION.

By ADELE M. FIELDE.

NOT long ago I engaged a new Chinese teacher, Mr. Khu, and as I was his first foreign acquaintance, as he had never tampered with books of Western origin, and as he was said to have made a special study of the occult sciences and to be devoutly religious, I considered him a treasure-trove. That which I here set down as the Chinese theory of evolution has been translated largely from Mr. Khu's expositions of cosmogony. It agrees with what I have gathered, through conversations in the vernacular, from other native scholars.

Neither Lau-Tse, Confucius, nor Buddha, the founders of the three great religions whose tenets harmoniously dwell together in the Chinese mind, has set forth an account of the making of the universe. But the human intellect seems to trend inevitably toward attempts to explain the existence of things seen, and so there is a Chinese theory of evolution, whose exact origin it is difficult to trace through the four millenniums and the myriads of volumes that hold the written history of the empire.

In the beginning all matter was transparent, diffused, and without differentiation. In it dwelt the dual powers; both subtle, ethereal, and eternal; but the one was virile, warm, radiant, and active; the other, feminine, cold, somber, and quiescent. These dual powers are symbolized by two similar, conjoined figures, whose outlines may be made by drawing upon the diameter of a circle two oppositely directed semicircles, whose centers are those of the two radii. The reciprocal action of the dual powers, continuing through ages, produced all that is. Puan Ko, sometimes represented as a giant holding up the sun and moon and shaping the mountains, is only the personification of the forces that wrought in chaos.



A zenith, a nadir, and all the points of the compass were gradually evolved. There came to be a distinction between the bright heavens, with the seven moving luminaries, and the dark earth, with its seas. The male principle predominated above, the female principle predominated below, as Father Heaven and Mother Earth, each having an all-pervading spirit, but with unlike influence. The body comes from and depends upon the earth; the soul comes from and returns to the heavens.

The rocks are the bones of the divine body, the soil is the flesh, the metals are the nerves and veins; the tide, wind, rain, clouds, frost, and dew are all caused by its respirations, pulsations, and exhalations. Originally the mountains rose to the firmament, and the seas covered the mountains to their tops. At that time there was, in the divine body, no life besides the divine life. Then the waters subsided; small herbs grew, and in the lapse of cycles developed into shrubs and trees. As the body of man, unwashed for years, breeds vermin, so the mountains, unlaved by the seas, bred worms and insects, greater creatures developing out of lesser. Beetles in the course of ages became tortoises, earth-worms became serpents, high-flying insects became birds, some of the turtle-doves became pheasants, egrets became cranes, and wild cats became tigers. The praying mantis was by degrees transformed into an ape, and some of the apes became hairless. A hairless ape made a fire by striking crystal upon a rock, and, with the spark struck out, igniting the dry grass. With the fire they cooked food, and by eating warm victuals they grew large, strong, and knowing, and were changed into men. There is a story that the ape who first taught cooking had a peculiar origin. He was imprisoned, from the beginning, in a rock on the sea-shore. The waves beat on the rock century after century, and at last wore away all except the ape that had been its center. Then the sun warmed him, and the winds breathed upon him, till he became alive, and with a divine impulsion went and taught his kind to cook their food.

Khu says: "In the early days of man there were peace and plenty, because no one disturbed or maltreated the body of God. Those who saw a stone removed from its natural site, wept, and carried it back and put it in the place from which it came. Children were taught that if they found a piece of metal they must not touch it. No silver, nor gold, nor jade was to be seen in any dwelling. To the wise, dreams were given, in which the universal parent spoke, saying: 'Child, the gold, the jade, the metals, and the gems are all parts of my body. Touch them not, nor meddle with them to my hurt and yours. To take stones from the earth is to dislocate the bones of one's parent; when the parent suffers, the dependent child is harmed.' In those days the soil was red and rich; it was heavy as iron, and so ductile that it could be drawn into filaments. There was no need of fertilizing the fields. Whatever was planted grew quickly, and the kernels of grain were as large as chestnuts, and the potato-tubers were as large as squashes now are. The products of the earth were so nutritious that one meal a day was sufficient, and so luscious were they that condiments were needless. It is the disrespect shown to the divine body that has made the life of man so hard. One should be content with what may be had without deeply disturbing the soil. The displeasure of Heaven is often manifestly visited upon the agriculturists who give the land no rest, and the lightning frequently strikes those who are at work in the fields. Those who walk on mountains soon tire, because they tread upon the bones, while those who keep to the artificial highways are not so soon fatigued."

This pantheistic theory being in its loftiest conceptions too abstract for the masses, it is expressed by them in the assertion that "there is a god to every eight feet of space." Every tree, grotto, and hummock has its tutelary deity. Consequently, no man begins to dig a cistern, to remove earth from a hill, to cut a stone, or to till a garden, without offering propitiatory gifts to the local divinity. If fever, headache, or dyspepsia follow the effort, the displeasure of the god is believed to be its cause, and the work is apt to be abandoned.

It is at once apparent that this pantheistic theory of evolution offers serious hindrance to the utilization of the metals contained in the mountains, to the opening of mines, the building of railroads, and the erection of structures requiring deep foundations. It has prevented the Chinese from availing themselves of the vast mineral resources of their country, from leveling thoroughfares where they are pressingly required for traffic, and from full use of the products of the earth in promoting the well-being of man. It is the chief reason why the emigration of hundreds of thousands of men in search of work has now become necessary. If the Chinese were unhampered by fear of the invisible ones who are considered by all to be the real proprietors of the land, they would have an abundance of lucrative work within their own borders, and they need not then afflict other countries by their immigration. The losses that accrue to them through this false theory are both positive and negative. It occasions an enormous outlay upon profitless offerings that must be bought with money earned by hard labor; and it prevents their use of the wealth stored in their lands. Affecting daily the welfare of hundreds of millions of persons, it well illustrates the practical evil of false doctrine, and, by contrast, shows the great economic value of truth.

SKETCH OF ALEXANDER WILSON.

A PECULIAR interest attaches to the lives and labors of pioneers. The circumstances which led to the discovery of a new continent, the first application of one of the forces of nature to the service of man, the making of the first instrument for viewing the stars, and the first description of the animals, plants, or physical features of a country, always have eager readers. Then, too, the personality of a man who has the courage and originality to set forth into an untrodden field is generally picturesque and inspiring. All these claims to attention are possessed by the pioneer American ornithologist.

ALEXANDER WILSON was born on the 6th of July, 1766, at Paisley, in Renfrewshire, which lies just south of the river Clyde. His father, Alexander Wilson, was a weaver, and reached the age of eighty-eight years, dying in 1816. During the latter part of his life, at any rate, the father was rated as a most exemplary citizen, but there is a glamour of "moonshine" about his early manhood, in the sense that, when not occupied with tending the loom, he operated a "wee still," from which trickled good Scotch whisky that was consumed without paying tribute to the tax-collector. This has naturally been denied, but not with entire success. His wife was a Mary McNab, of a strictly pious character, and with the beauty that frequently accompanies a tendency to consumption. Of this disease she died when young Alexander, who was one of three children, was ten years old.

Like many devout Scottish folk, the parents of "Alic," especially his mother, cherished the ambition that their boy should "wag his head i' the puppit yet," but his genius did not lie in the direction of the ministerial office. He attended the Grammar School of Paisley, but his schooling must have been interrupted and of no great amount, for much of his boyhood was otherwise occupied, and his deficiencies in grammar, spelling, etc., clung to him till manhood. He is known to have struggled with his backwardness in arithmetic after emigrating to America. His handwriting was called excellent, and his language was simple and idiomatic. The taste for reading, which he early developed, largely made up for his scanty schooling. At one time he was sent to be a herd on a farm called Bakerfield, not far from Paisley, where he remained probably not more than a single summer. It is said that "he was a very careless herd, letting the kye transgress on the corn, being very often busied with some book."

In his thirteenth year he was bound apprentice as a weaver, for three years, to his brother-in-law, William Duncan. Having served out his time in 1782, he continued a weaver "by constraint, not willingly," for four years, living part of the time under his father's roof in Paisley and in Lochwinnoch, and finally with his brother-in-law at Queensferry. His taste was for outdoor life, and he had inherited a feeble constitution from his mother, so that the loom was irksome to him both mentally and physically. During this period young Wilson began to contribute verses to the local newspapers. His best piece, however, "Watty and Meg," was published in 1792, as a penny chap-book, without his name, and was ascribed to Robert Burns. The latter, who lived not far away, and was but six years older, strengthened the compliment by avowing that he should have been glad to be its author. Wilson's descriptive pieces are interesting, from the evidence they give of his natural fondness for the woods and fields.

After a while Duncan decided to "travel" as a peddler through the eastern districts of Scotland, and invited Alexander to accompany him. Accordingly, the two abandoned the loom and entered upon their new occupation. The Scotch peddler of that time was generally a man of shrewdness and common sense, probably resembling the best type of our own departed Yankee peddler, and was generally respected by the common people, but often suspected and despised by the wealthier. This occupation, although it delivered Wilson from the confinement of the weaving-room, was not all sunshine. It involved trials and rebuffs, which to a man, as Grosart * calls him, "of sensitive, strangely refined if also in elements as strangely coarsened temperament," must have been hardly borne. His "Journal as a Pedlar," several poems bearing on his experiences of the road, and his earlier letters, give a realizing sense of the lights and shadows of this kind of life. In addition to his trading, he solicited subscriptions for a volume of poems, which he published in 1790.

In a short time he dropped the pack and returned to his hated trade of weaving. Being in ill-health and sorely oppressed by poverty, he was at this period much given to despondency. Yet he

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* "The Poems and Literary Prose of Alexander Wilson," edited, with Memorial Introduction, Essay, etc., by the Rev. Alexander B. Grosart, two vols., Paisley, 1876.

had a humor which enabled him at times to joke about his necessities. He had a gift of satire, also, which got him into some trouble, but which was the cause of his taking the first step in the path that led to fame. Industrial affairs in Great Britain at that time were greatly unsettled. Many of the Paisley weavers were unemployed, and capital and labor were arrayed against each other. Some of the turbulent spirits among his fellow weavers induced the enthusiastic young Wilson to use his talent for verse-making to abuse the capitalists. Several poems of his, portraying in no flattering light certain local petty tyrants, were adjudged libelous, and Wilson, who manfully acknowledged their authorship, was fined heavily, and condemned to burn the poems in public. Being unable to pay the fine, he was sent to jail.

In this hour of gloom, Wilson's eyes were turned to the New World. Attracted by the chances for winning his way open to a free man in a new country, he determined to emigrate. Accordingly, he and his nephew, William Duncan, sailed from Belfast Loch, Friday, May 23, 1794, and after a voyage of over seven weeks landed at Newcastle, Delaware. Wilson was then twenty-eight years old. He and young Duncan went first to Wilmington, and from there to Philadelphia, looking for employment at weaving. At the latter place, he writes in his first letter home to his father and step-mother, "we made a more vigorous search than ever for weavers, and found, to our astonishment, that, though the city contains between forty and fifty thousand people, there is not twenty weavers among the whole, and these had no conveniences for journeymen, nor seemed to wish for any: so, after we had spent every farthing we had, and saw no hopes of anything being done that way, we took the first offer of employment we could find, and have continued so since." This employment was in the shop of a copper-plate printer. The above quoted letter was a long and very newsy one, and contains Wilson's first observation of the feathered creatures that were to make his fame. He writes: "As we passed through the woods on our way to Philadelphia, I did not observe one bird such as those in Scotland, but all much richer in color. We saw a great number of squirrels, snakes about a yard long, and some red birds, several of which I shot for our curiosity."

Wilson remained in his first found employment but a few weeks. After that he worked at his trade of weaving at a place ten miles north of Philadelphia, and for a short time in Virginia. In 1795 he tramped through northern New Jersey as a peddler. He had been in America but little over a year when he took up school-teaching, and at this occupation he succeeded remarkably well, although it gave him only a scanty income. He first opened a school at Frankford, but soon gave it up to become master of the school at Milestown, in Philadelphia County, where he taught for nearly six years. His own education had been limited; so, after he began to teach, he had to study diligently to make up his deficiencies. He advanced so far in mathematics that he was enabled to take occasional employment as a surveyor.

After leaving Milestown he taught for a while at Bloomfield, N. J., but he found this place disagreeable, and he was at the same time burdened with a trouble, only dimly revealed in his letters, but in which one of the Milestown young ladies figured. He became very despondent, and even thought of returning to Scotland. It was not long before he obtained a school at Kingsessing, near Gray's Ferry, on the Schuylkill. His removal to this place was attended with important results. He became acquainted with William Bartram, whose famous garden was not far away, and with Alexander Lawson, the engraver, both of whom became his steadfast friends. Bartram lent him books, among them, the works of Catesby and Edwards. In the parts of these works relating to American birds, Wilson's own acquaintance with the birds was enough to show him an exasperating number of errors, false theories, and caricatured figures. During the early part of his life at this place Wilson was so despondent that Lawson at one time feared for his reason, and advised him to give up poetry and his flute, which seemed to increase his melancholy, and to take up drawing. This accomplishment does not seem to have come very naturally to him, for he made a failure of the landscapes and human figures which Lawson set before him. Still, the statement of an American writer, that he was "without any previously suspected aptitude," is denied by Mr. Grosart, who adds that drawings by him before he left Scotland are preserved in the Paisley Museum with the collection of Wilson's manuscripts. Bartram and his niece, Miss Nancy, started him again on easier subjects, first flowers, and then birds, with which he made encouraging success.

It is in a letter to one of his Scottish biographers, his old friend in Paisley, Mr. Thomas Crichton, under date of June 1, 1803, that Wilson's determination to study the birds of America is earliest recorded. "Close application to the duties of my profession," he writes, "which I have followed since November, 1795, has deeply injured my constitution, the more so that my rambling disposition was the worst calculated of any one's in the world for the austere regularity of a teacher's life. I have had many pursuits since I left Scotland—mathematics, the German language, music, drawing, etc., and I am now about to make a collection of all our finest birds." At first he devoted only leisure hours to the birds, and his figures "were chiefly colored by candle-light," but he soon began to make longer and longer expeditions. In October, 1804, he set out with two companions, on foot, to visit Niagara. From there he went through the lake region of central New York, visiting his sister and her children, who were living on a farm that Wilson and his nephew William had bought together. He made his way home down the Mohawk Valley to Albany, and thence by boat to New York. In this journey, occupying two months, he traversed over twelve hundred miles. Winter overtook him in the midst of it, so that the latter part of it was made "through deep snows and almost uninhabited forests; over stupendous mountains and down dangerous rivers." The trip seems to have benefited both his health and spirits, for in his account of it, written to Bartram, he expresses eagerness for wider explorations and new discoveries. "With no family to enchain my affections, no ties but those of friendship, and the most ardent love of my adopted country; with a constitution which hardens amid fatigues, and a disposition sociable and open, which can find itself at home by an Indian fire in the depth of the woods, as well as in the best apartment of the civilized [world], I have at present a real design of becoming a traveler. But I am miserably deficient in many acquirements absolutely necessary for such a character. Botany, mineralogy, and drawing I most ardently wish to be instructed in, and with these I should fear nothing." How oblivious to matters of detail his enthusiasm made him can be judged, Ord * remarks, from the fact that at this time Wilson's available cash amounted to *seventy-five cents*.

Two of the birds which he shot in New York, one being the Canada jay, were unknown to Wilson's associates. He made careful drawings of them, and got Mr. Bartram to send them to President Jefferson, whom Wilson much admired. The President, who was quite an amateur naturalist, replied with a very appreciative letter, in which he put Wilson on the track of a certain sweet-singing and very unapproachable bird. He had "followed it for miles without ever, but once, getting a good view of it," and had for twenty years tried to get a specimen without success. "After many inquiries and unwearied research," says Ord, "it turned out that this invisible musician was no other than the wood robin, a bird which, if sought for in those places which it affects, may be seen every hour of the day." The next summer Wilson announced to Bartram his determination to make a collection of drawings of the birds of Pennsylvania, and sent him twenty-eight for criticism. The scope of his undertaking was extended, within a few months, so as to include the whole United States. He had planned an expedition down the Ohio and Mississippi Rivers for the summer of 1806 with Bartram; but the latter, who was nearly seventy years old, gave up the idea. Wilson, who had heard that explorers were to be sent up the Red and Arkansas Rivers, through the recently acquired Territory of Louisiana, then offered himself to President Jefferson for this service. "Mr. Wilson," says Ord, "was particularly anxious to accompany Pike, who commenced his journey from the cantonment on the Missouri, for the sources of the Arkansas, etc., on the 15th of July, 1806." But no reply was made to his application.

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* "Life of Alexander Wilson," by George Ord. In Volume IX of the "American Ornithology."

In April he was engaged by the publishers, Messrs. Bradford and Inskeep, as assistant editor for the revision of Rees's "New Cyclopædia," on "a generous salary," namely, nine hundred dollars a year. He now gave up school-keeping, which had been his calling for ten years. While in this position, he made known his plans for the "American Ornithology" to Bradford, who readily agreed to undertake its publication. A prospectus was immediately issued, and a year later, in September, 1808, the first volume of the work appeared. In the fall of that year he made a trip through New England, "in search of birds and subscribers." On the way from Philadelphia he stopped at Princeton, to show his work to the college professors. He expected to get some valuable information on American birds from the Professor of Natural History, "but," he writes, "I soon found, to my astonishment, that he scarcely knew a *sparrow* from a *woodpecker*." Wherever he showed his book to college professors, and other literary men, the highest praise was lavished upon it, but subscriptions were not so freely forthcoming, the price, one hundred and twenty dollars, being a serious obstacle. He wrote from Albany, on his way home, that he had obtained only forty-one subscribers. One of the less intelligent personages, whose favor he had sought, was the then Governor of New York—Daniel D. Tompkins. This magnate, as Wilson informs us, "turned over a few pages, looked at a picture or two, asked me my price, and, while in the act of closing the book, added, 'I would not give a hundred dollars for all the birds you intend to describe, even had I them alive.'"

He soon set off again on a trip through Baltimore, Washington (where he was received "very kindly" by Jefferson), and other Southern cities, and when he reached home had in all two hundred and fifty subscribers. In the South he shot several new birds. It was now deemed advisable to add three hundred impressions of Volume I to the two hundred first struck off, and the second volume started with an edition of five hundred copies. His undertaking had already won him "reputation and respect," but the pecuniary return was still doubtful.

Volume II of the "Ornithology" was ready in 1810, and in February of that year Wilson set out on another hunt for new specimens of the feathered tribes and those rare birds—subscribers. His varied adventures on these expeditions, and his impressions of the people and places that he visited, are delightfully recorded in the letters which Mr. Grosart collected.

At Hanover, Pa., he met a judge who condemned his work because "it was not within the reach of the commonality, and therefore inconsistent with our republican institutions." Wilson turned the tables on this learned man by showing that the judge's elegant three-story brick house was open to the same objection; and then in a more serious vein pointed out to him the benefit which a young, rising nation can derive from science, "till he began to show such symptoms of intellect as to seem ashamed of what he said." From Pittsburg Wilson made his way in a skiff down the Ohio over seven hundred miles, nearly to Louisville, stopping at the important towns on the way.

At Louisville one of the persons on whom he called was Audubon, then thirty years old and engaged in business. Audubon has left an account of this meeting, in which he thus describes Wilson's physical appearance: "How well do I remember him as he walked up to me! His long, rather hooked nose, the keenness of his eyes, and his prominent cheek-bones, stamped his countenance with a peculiar character. . . . His stature was not above the middle size." Audubon claims that he was about to subscribe for the "Ornithology," but a complimentary reference to his own knowledge of birds, spoken in French by his partner, checked him. "Vanity and the encomium of my friend prevented me from subscribing," he writes, and to this he adds that he lent some of his drawings to Wilson, and hunted with him, obtaining some birds which the latter had never seen before. Audubon states also that being in Philadelphia some time afterward he called on Wilson, who received him with civility, but did not speak of birds or drawings. Against this story must be set the following extract from Wilson's diary published in the ninth volume of the "Ornithology": "March 23d, I bade adieu to Louisville, to which place I had four letters of recommendation, and was taught to expect much of everything there; but neither received one act of civility from those to whom I was recommended, one subscriber, nor one new bird; though I delivered my letters, ransacked the woods repeatedly, and visited all the characters likely to subscribe. Science or literature has not one friend in this place." "We must take Audubon's account," says his own biographer, Robert Buchanan, "*cum grano salis*," while Grosart, eager in defense of Wilson, does not hesitate to call it "a tissue of lies," except his admission that vanity kept him from subscribing to Wilson's work.

Turning southward, Wilson crossed Kentucky to Tennessee, and proceeded through the Chickasaw and Choctaw countries to Natchez, and thence went to New Orleans.

By persistent labor the successive volumes of the "Ornithology" were issued up to the seventh, which appeared in the spring of 1813. On the 6th of July in that year he wrote: "I am myself far from being in good health. Intense application to study has hurt me much. My eighth volume is now in the press and will be published in November. One volume more will complete the whole." But he was not to see the appearance of even the eighth volume. The unremitting labor of that summer, carried on in the city, where even his tramps with his gun were cut off, so reduced his strength that he succumbed to an attack of his old enemy the dysentery and died, August 23, 1813, at the age of forty-seven. The immediate cause of the attack was his swimming a river in pursuit of a rare bird that he caught sight of while visiting a friend. Wilson died unmarried, although in his letters he condemns celibacy, and shows that he was not indifferent to female companionship. In fact, he was to have married a Miss Miller, whom he made one of his executors. George Ord, who had accompanied Wilson on some of his trips, was made a co-executor, and completed the publication of the "Ornithology," prefixing to the last volume a life of the author. The original edition of Wilson's great work is now rare. It comprises nine thin folio volumes, about eleven by fourteen inches in size. Several birds are figured on each plate—the smallest ones of life-size, the others reduced. An edition in three volumes, including the birds afterward described by Prince Bonaparte, was issued in 1829–'36,* and another in four volumes, edited by Prof. Robert Jameson, in 1831.

Wilson was no compiler; he took his facts from his own observations, or the accounts of those who had known the birds for a lifetime. He had, further, as Grosart says, a "magnetical sympathy with the birds whereby his descriptions of their looks and ways and faculties take the coloring of so many little biographies of personal friends."

Sir William Jardine says of Wilson: "He was the first who truly studied the birds of North America in their natural abodes, and from real observations; and his work will ever remain an ever-to-be-admired testimony of enthusiasm and perseverance—one certainly unrivaled in descriptions; and if some plates and illustrations may vie with it in finer workmanship or pictorial splendor, few, indeed, can rival it in fidelity and truth of delineation."

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* "American Ornithology," by Alexander Wilson and Prince Charles Lucien Bonaparte. Edited, with a Life of Wilson, by Sir William Jardine, Bart.

CORRESPONDENCE.

FARMING AND THE TARIFF.

Editor Popular Science Monthly:

DEAR SIR: The article in your November issue, by Joel Benton, on "The Decadence of Farming," greatly interested me, as it must every lover of our country, and it suggested several questions which I believe should be considered, that we may get at the facts.

The reasoning is that, because farming has decayed at the same time that a protective tariff has prevailed, which has enhanced, as it is claimed, the cost of what the farmer has had to buy, therefore the tariff is responsible for this decay. Saying nothing of the claim that the tariff does in the long time enhance the price of what the farmer has to buy, let us ask how free trade has helped the farmers in Great Britain. Is it not a fact that during these same years farming has decayed there fully as much as in our own country? The wonder is how, with produce so low, the Irish farmers can pay their rent, and many can not, and the land-owners' profits have almost disappeared. A Yorkshireman recently told the writer that he knew of many large farms the owners of which would be glad to give a lease for a term of years *for no rent*, if the land could be kept up. Now, by parity of reasoning, may we not say that, seeing farming has decayed in Great Britain, at the same time that free trade has prevailed, which has brought down the price of what the farmer has to buy, therefore free trade has caused the decay of farming? Is it any better in free-trade Holland, from which the farm laborers are coming to the writer's own community, because the best farm laborer there can get but forty cents a day, whereas here he gets at once more than double? Do not these facts suggest the question whether there are not other causes besides tariff or free trade which may account for this manifest decay of farming?

Has not the wonderful cheapening of transportation brought cheaper and, for a time, more fertile soils into competition with the dearer and worn-out soil of our older States? Cereals and meat and wool can be raised so cheaply on these new lands that the Western farmer, with the low cost of transportation added, can undersell the farmers of the older States. The same is true in the case of Great Britain. And this power to undersell is increased by the use of machinery in farming, which use can be so much greater and more effectual on the large farms of the new States than in the older States. A bushel of wheat or corn can be raised with a small part of the labor cost in Kansas or Dakota as compared with New York. The result is, that in the older States the farmer is compelled to look for his profits to raising the products that will not bear transportation, either because they are perishable, as milk, or because they are too bulky, as hay. He must depend upon the near-by market, and supply it with what the farmers of the West can not send it.

Does not this suggest another thought? We must look for relief, not in the direction of urging more to engage in farming, but by finding, if possible, other employments for men which are more profitable; and this, many of us still believe, can be done better with a wisely adjusted protective tariff than with free trade, which would tend to crowd still more the already overfull ranks of the farmers. JOHN R. THURSTON.

WHITINSVILLE, MASS., *October* 30, 1889.

A REMONSTRANCE.

Editor Popular Science Monthly:

SIR: I have been accustomed to read with a high degree of pleasure the contributions of Mr. Grant Allen which I have seen from time to time in your pages. Reading in your December number his "Plain Words on the Woman Question," copied from the "Fortnightly Review," I rubbed my eyes once or twice over the following words, which seem, after a second or third perusal, much *too* plain:

"Whether we have wives or not—and that is a minor point about which I, for one, am supremely unprejudiced—we must at least have mothers."

Calving must go on, no doubt, if the race of horned cattle is to be kept up, and it is not important that calves should know their own fathers, or have an acknowledged parentage on the male side. It is quite otherwise with human beings, and I submit that no teacher of biology can afford to be without a bias in favor of wives, looking strictly at human progress, which is the great desideratum of the article in which this extraordinary passage occurs.

Possibly the words quoted may have a biological meaning somewhat different from the obvious meaning. If so, Mr. Grant Allen should be cautioned, when writing for the laity, to use the kind of language which they understand. If the obvious meaning is the real meaning, I have only to say to him, "Never more be officer of mine." H. W.

NEW YORK, *November* 30, 1889.

Mr. Allen, we are sure, is the very last man who would deliberately say anything calculated to encourage immoral tendencies.

There is, however, in this particular controversy, much excuse for the plain speaking to which our correspondent takes exception. The real woman question, which, as Mr. Allen points out, is whether woman shall unsex herself or not, has long been obscured by a sort of sentimental glamour which is daily exerting the worst kind of influence in society; and when the scientific man takes up the subject, it becomes his duty, if he would be true to the spirit of his craft, to set forth in the strongest light the essential facts of the case. All through his article it is the biological question involved which Mr. Allen keeps to the front, and in the passage complained of he, as we read him, is simply emphasizing the supreme importance of this aspect of the subject.—EDITOR.

ENVIRONMENT AND THE REPRODUCTIVE POWER OF ANIMALS.

Editor Popular Science Monthly:

I HAVE read with great interest an article in the November number of "The Popular Science Monthly" entitled "Conditions affecting the Reproductive Power of Animals," and, while I fully agree with the facts as stated, it seems to me that the manner in which it is written savors overmuch of the "carpenter theory of creation."

I do not deny that "the activity of the reproductive function is in proportion to the unfavorableness of the embryonic environment"; but is not this a fact rather than a law? It is true that the power of producing young in immense numbers is the *conditio sine qua non* among lower orders of animals, but should we not look deeper for the reason of this power? Are there any laws in nature which exist simply because they are good?

Among the lower orders of animals the weight of each offspring is much less in proportion to that of the parent than among the higher. The organization of the lower orders being much simpler than the higher, the offspring can be brought to perfection in a much shorter time. Therefore, each individual offspring of the lower orders is produced with much less expenditure, on the part of the parent, of both matter and vitality. Were these the only differences, they would be sufficient to account for a vast difference in reproductive power.

This reproductive power is fostered by natural selection. Among those species whose young are exposed to so many chances of destruction, those varieties which possess the greatest reproductive power are more likely to survive in the struggle for existence, and will transmit to their offspring their more vigorous reproductive power. To say that the reproductive power of an animal can be affected directly by anything which may happen to the offspring after birth reminds us of the belief current among children that, if a lost tooth be swallowed by a dog, a dog's tooth will grow in its place.

We know that the existence of a species in any given state depends upon certain conditions. While the study of that species may teach us much concerning those conditions, it is necessary for us to take a wider and deeper view before we can discover the causes which led to them; and we should ever keep in mind the fact that while the species owes its existence, in any given state, to those conditions, the conditions were not necessarily created by Nature for the sake of preserving the species in that particular state. Nature helps those, and only those, who help themselves.

CHARLES A. PEPLE.

RICHMOND, VA., *November* 4, 1889.

A CORRECTION.

Editor Popular Science Monthly:

DEAR SIR: My attention has been called to a slip occurring in my article in the April issue of the "Monthly." In the sentence (in the foot-note, page 727) reading ". . . Add to this the confession of an exposed medium, Mr. D. D. Home," etc., the exposed medium is not D. D. Home, but one cited by him as exposed. The only hint I have as to the origin of the printed version is from my fragmentary notes for the paper, in which the words stand thus: "Add to this the confession of an exposed medium (D. D. Home, 'Lights and Shadows of Spiritualism,' etc.)." I remember deciding to omit all mention of names wherever possible, and must have crossed off part of the parentheses instead of all. I am very sorry that so slight an error should have ended in throwing blame where it did not belong, and especially so as my point was simply that *a* medium was exposed in the manner indicated, it being entirely immaterial who the medium might be.

I must further apologize for the lateness of my writing, on the plea of a six months' absence abroad, and the consequent accumulation of duties awaiting me on my return.

Truly yours,

JOSEPH JASTROW.

MADISON, WIS., *Oct.* 31, 1889.

EDITOR'S TABLE.

TOLSTOI'S "CONFESSION."

AMONG the numerous writings from the pen of Count Tolstoi which have of late been made accessible to the English reader is one entitled "My Confession." In this work the author tells us that, having in his youth led the life of a pleasure-loving man of the world, and in his maturer years of a literary man in considerable repute, he woke up in middle life, when all his outward circumstances were highly prosperous, to find that life to him seemed to possess no meaning and no value. He could find no answer to the Carlylean questions "Whence?" and "Whither?" and so distressed was he thereat that for a long time he was haunted by the thought of suicide. He had recourse to science, and could get no light; to philosophy, and could reap no consolation. It seemed to him as if some tyrant had called him into existence simply to make a mock of him, by hiding from his eyes the answer to life's riddle—by implanting in him an instinctive love of life, and yet depriving him of the knowledge which alone would supply a rational motive for living.

The nature of Tolstoi's trouble is fully explained in his book. His youth had been one of passion and riot, unguided by any principle save the loose code of honor prevalent in military circles. As an author he had encountered men with whom literature was a means for the gratification of vanity and nothing more, whose aims were sordid, whose ideas were conventional, and whose lives were actually worse than those of the wild companions of his youth. Yet these men set themselves up for guides of society and final arbiters in all questions of taste and morals. Tolstoi himself had caught their tone, and for a time imagined that, because he enjoyed popularity as a writer, he must necessarily be a very superior person. According to the ideas prevalent among his literary friends, the world existed for hardly any other purpose than to provide them with the opportunity for airing their superiority. It is not surprising that a man of Tolstoi's sensibility should eventually have been led to see the falsity of this whole view of life; the only wonder is that he did not revolt against it sooner than he did. The thoughts that came to him toward middle life have come to some others much earlier. The poet Clough was only twenty-two when he wrote:

> "How often sit I poring o'er
>   My strange distorted youth,
> Seeking in vain, in all my store,
>   One feeling based on truth;
> Amid the maze of petty life
>   A clew whereby to move,
> A spot whereon in toil and strife
>   To dare to rest and love!"

The life of Tolstoi had been essentially based upon privilege. He had lived above the mass of mankind, and had imbibed the narrow ideas of an exclusive set. He had not taken humanity into his thoughts, except for purposes of literary treatment; and, therefore, when a period of calm reflection came, though his intellectual pride took flight, and his false ideas stood confessed in their falsity, what to do he knew not. It seemed to him that he had to construct a new philosophy of life, and in the search for a solid basis for such a philosophy he endured the distress which he has so vividly described. He attacked the problem, however, from the wrong side, asking questions which only metaphysicians or theologians have ever attempted to answer, and which have never been answered in any satisfactory manner. After many wanderings and many perilous lingerings on the very verge of despair, he bethought himself of the thousands and millions of human beings who go about their daily tasks and take up their daily burdens without repining or misgiving, who find a natural sweetness in life, and never think of worrying themselves over questions of ontology or metaphysics. These, he said to himself, must possess the true secret of life, and the best thing I can do is to learn it of them.

Tolstoi was here getting upon solid ground. His previous life had been governed without any reference to cardinal principles of duty or to the essential relations of human beings to one another. One of the aphorisms of the founder of the Positive Philosophy is that between individual man and the universe humanity is needed as mediator. Suppress humanity, that is to say, suppress all true thoughts in regard to humanity, suppress the sense of inclusion in and identification with the great human whole, and individual man is indeed a poor, defenseless thing, or, as Matthew Arnold has expressed it—

"A naked, eternally restless mind."

No words could describe better than these the true condition of the great Russian's mind when the scales had fallen from his eyes, and he realized in what a vain show he had been walking. Peace came to him through his suddenly awakening to a sense of the vastness of the life of humanity, and his sudden resolve to take refuge in it, and, as far as possible, to make its thoughts and feeling his own. The lesson in all this is obvious, and it is in direct line with our remarks in a previous number under the head of "The Domain of Science." There is a science of life. There is a way of regarding our relations to the world at large which is true; and, unfortunately, there are many ways of regarding them which are false. There are thoughts, tempers, dispositions, habits, that make for soundness both of mind and body, and there are others in great variety that make for unsoundness. There are certain normal conditions of existence determined by the whole course of human evolution; and these can not be too widely departed from, under the guidance of purely individual feelings, without serious danger. The work of placing life on a sound basis may be begun at any time, though early is indeed much better than late. It is all a question of seeing things in their right relations and acting accordingly—all a question of extending the domain of science from biology and physiology to sociology and individual conduct. Rightly read, Tolstoi's "Confession," though it mentions science but disparagingly, should be a great help in this direction. It certainly contains a grave warning against the tyranny of the passions and the utter hollowness of much that passes for literature and philosophy.

THE LAND QUESTION.

It is almost needless to direct attention to the letters on the land question published in this issue, as the names of certain of the writers would alone create interest in the discussion. Mr. Spencer, unfortunately, has been for some time in a state of health that almost wholly incapacitates him for the labor of the pen; and, though he has given us two very interesting letters, most readers will feel that he has hardly done full justice to his own position. He has confined himself to the criticisms of Prof. Huxley, and passed unnoticed those of Mr. Greenwood and Sir Louis Mallet. Had he possessed his old-time fire and energy, he would probably have dealt with all his critics in a manner that would have left little to be desired; we may be sure at least that he would have considered fully and fairly all their objections to his views, and would have given any necessary explanations in that spirit of candor which has always distinguished him.

It will be noticed that Mr. John Laidler, "bricklayer," is disposed to be severe upon Mr. Spencer for having in part abandoned the views expressed by him as long ago as the year 1852, in his work on "Social Statics." It is hardly worth while, however, to be a philosopher if a man can not mature and, if necessary, modify his views as he advances in life and gathers the fruits of experience and reflection. Mr. Spencer long ago recognized that in his "Social Statics" he had expressed himself somewhat unguardedly on the land question; and he has refrained for many years from giving any currency to his earlier opinions on that subject. Had his health permitted, it is not improbable that he would have taken some recent occasion for reviewing the whole question, and giving the world the benefit of his latest thought. As it is, he is obliged to content himself with indicating the germ of truth in his former views, and the modifications and safeguards he would now attach to the enunciation of the general principle which they embodied.

Mr. Frederick Greenwood, who participates in the discussion, undertakes to point a serious moral, to the effect, namely, that philosophers should be careful how they scatter abroad ideas which may serve as the seeds of revolution. The caution reminds us of a famous one given by St. Peter to St. Paul, some of whose writings, the former apostle thought, "the unlearned and the unstable" might "wrest to their own destruction." It was St. Paul, however, with his bent toward philosophy, who moved the ancient world to embrace Christianity. What his critic did in that direction is not very conspicuously recorded on the page of history. Mr. Spencer has labored hard to rationalize the thought of his age, to bring the minds of men into contact with the laws that—whether we recognize them or not—govern human life; and if, by some, his teachings are misunderstood and misapplied, we must judge of his total influence, not by such cases, but by the whole volume of mental activity that owes its origin to his writings.

The general impression which the controversy will leave on the minds of most readers will be, if we mistake not, that the land question is a good one to leave alone—at present. Not that there are not many abuses connected with the tenure of land waiting to be corrected; but that the correction of such abuses can best be accomplished without raising the fundamental question as to whether land can or can not be held by as good a title as chattel property. In this country, a few years ago, we had a slight wave of excitement in connection with the theories propounded in Mr. George's "Progress and Poverty"; but the conviction has been strengthening, we believe, in most thoughtful minds that, plausibly and eloquently and earnestly as Mr. George has presented his ideas, their adoption could only lead to social and political confusion. The world at large will be better when men individually are better; and social justice will reign when individual justice reigns. The land requires to be appropriated to and by individuals in order that the best and most profitable use may be made of it; but it does not follow that the individual occupier should act the part of a tyrant toward his fellow-men. A man may do that without owning a foot of land. Every man who follows a gainful trade or profession has an interest in the land, seeing that those who own and till it, own and till it for him to the extent of the demand expressed by his wages or emoluments. The world wants justice and wants it now; but it would be a poor inauguration of justice to turn title-deeds to which society has given every possible sort of sanction into waste paper, and virtually confiscate the honest earnings, invested in land, of millions of honest men.

THE TWENTIETH BIRTHDAY OF "NATURE."

"Nature," now accepted as the foremost scientific journal in Europe, signalizes the beginning of its forty-first volume by reviewing its own career and the advancement of science during the twenty years that have elapsed since its first number was issued, in November, 1869. It came forward without obtrusive advertising, and without making any promises other than what was implied in the statement in Prof. Huxley's introductory article that its aim would be "to mirror the progress of that fashioning of herself in the mind of man which we call the progress of science." It now claims, with a justice that all its readers will recognize, that it "has not disappointed the hopes of its founders, nor failed in the task it undertook." Its pages fairly reflect the aspects which scientific discussion has assumed from year to year; and every established conclusion has been suitably noticed in them as it gained the right to claim attention. The reader can turn to its columns for facts bearing on all matters of interest of this kind, in the assurance that he will find them there. "Nature" has been able to accomplish this purpose, it says, by enlisting the co-operation—in contributions, and by advice and suggestion—of the leaders in all branches of research, and by showing its desire to be for the good of science and the promotion of knowledge—regarding these as of more importance than journalistic success. While its most prominent function has been to present at first hand the results of the work of these men, it has not disregarded the laity of science. Besides taking pains to present its professional articles in a form acceptable to the great body of unlearned inquirers, it has in its correspondence department given them a free parliament for discussion. Making itself a faithful mirror of scientific thought, it speedily gained favor among English readers; extended its reputation abroad; and became the one journal indispensable to students in every branch and every land.

Its record of the achievements of science during its lifetime, though consisting only of the briefest mentions, is a large one, and includes such facts as the establishment of the Darwinian theory, the periodic law in chemistry, the determination of a relation between electricity and light, the progress of bacteriological investigation, the advance of spectroscopical discovery, the vast expansion of physiological research, and many other matters of hardly inferior moment. In all these achievements English investigators are exhibited as among the most active, solid in work, and thorough in inquiry; and none have been more sagacious than they in generalization and in applying principles to practice. Not the least important of the results is the education of a generation who have sufficient knowledge of science to recognize its importance and give it its true position; so that, when now it points out a new field of inquiry or asserts a new principle, it has no longer apologetically to face suspicion and hostility, but meets a friendly and helping public.

LITERARY NOTICES.

Recent Economic Changes and their Effect upon the Production and the Distribution of Wealth, and the Well-Being of Society. By David A. Wells, LL. D., D. C. L. New York: D. Appleton & Co. Pp. 493. Price, $2.

Two years ago Mr. Wells contributed to "The Popular Science Monthly" a series of articles entitled "Recent Economic Disturbances." They elicited so much comment and discussion that the author now presents them as a book. In so doing he has brought his record of fact down to date, and extended his review so as not merely to treat the economic derangements which date from 1873–'74, but to include the economic history of the past three decades.

In comparing the present earnings of labor and assets of capital with the figures for 1860, Mr. Wells shows that the economic advance of the last thirty years has been little short of revolutionary. Science applied to field and farm, mill and factory, ship and railroad, has enormously increased the efficiency of labor. Hence the remarkable rise in wages, and the correlative fact of the fall of prices which makes a dollar exchangeable for more food and clothing than ever. Although the fortunes of men have been steadily improving, heightened sensibility, progress in social ambition, all that goes to raise the standard of living, have kept pace with the increase of popular luxury and refinement. Then, too, the blessings of industrial evolution, though general, have not been universal; and in considering its incidental pains and penalties Mr. Wells is both candid and sympathetic. He notes how handicraft skill is rendered valueless as machinery supersedes trade after trade. Old-time shoemakers now only get cobbling to do, and the tinsmith who once made all the paraphernalia of the kitchen is to-day no more than a tinker. Minute subdivision of labor reduces an operative to a mere tooth on a wheel; disrupted from it by an untoward accident of trade, he is of little more worth than a bit of scrap-metal. In manufactures and commerce modern exigencies demand a discipline which almost completely effaces individuality: both employers and workmen are subordinated as parts of a vast and complex enginery. In undergoing the painful and costly readjustments enforced by new economies, capital and labor have been partners in distress, and labor has not suffered more than capital. The increase in the average man's wealth has been partly at the expense of certain unfortunate classes of capitalists. While one set of farmers are being enriched by the rise in the value of Dakota lands, another set in France and England are being impoverished by the cheapness of Dakota wheat. The Suez Canal, in shortening the route between Europe and the East, effected a saving in freights greatly to the advantage of consumers of tea, silk, cotton, and spices: it also threw into idleness a vast fleet of ships adapted to the voyage around the Cape of Good Hope, and ruined a lengthy chain of interests vested in things as they were. The discovery of excellent coal and iron-ore near together in Alabama cheapens iron, but it extinguishes furnaces in the Northern States built at enormous outlay, and leads to the abandonment of large foundry properties in New York and New England. Every new machine and process, while it enriches the community, entails loss on individuals for expensive plant which must go to the scrap-heap.

While Fortune in the economic world has in the main been prodigal of her gifts, those upon whom her lash has fallen very naturally demean themselves differently from those upon whom she has smiled. While the cultivation of inconspicuousness on the part of millionaires is far from uncommon, those who have seen their possessions melt away in the discarding of old machinery, old methods, and old routes, make loud complaint. Of equal loudness is the alarm vented by those who have reason to fear loss through the supersedure of their property as Science marches on. This complaint and this alarm have been so sustained as to create an exaggerated impression of the evils economic progress brings in its train. Left to themselves, economic forces would merge the world into a single competitive field, the markets of which would be supplied only from the sources where capital and labor could work to most advantage. The redistribution of populations and employments which this would entail is a price a majority of civilized nations refuse to pay: its incidental loss and misery impress their imagination too deeply. Yet the choice is between this shunned evil and a greater. Vastly more is lost by declining to enjoy the gifts new knowledge stands ready to confer, in declining the harvests labor can reap when free to sow and till where natural conditions most favor it. Nothing in Mr. Wells's book is more impressive than the picture he draws of European nations severally striving by force of law to overcome some defect in soil, climate, position, or skill. France, for example, excludes American wheat as far as she can by a high duty. Does she not thereby injure the population of bread-eaters more than she eases the lot of a few wheat-growers? The vanity of attempts to juggle with inexorable Nature has imperilled interests higher than those of wealth; these attempts have checked the good-will which was springing up as trade united international interests and foreigners were coming to be strangers. In making battle-fields of their custom-houses, ethnic dislike has, doubtless, served to stimulate commercial jealousy among the people of Europe, and this in its turn fans the animosities which endanger peace.

While their neighbors have been indulging in costly tariff reprisals upon each other, the British, Dutch, and Swiss, firmly holding to freedom as the right rule of trade, have, perhaps unconsciously, borne testimony to economy and ethics being fundamentally one. Theirs has been the chief progress not only in wealth, but education, the abatement of crime, the lengthening of life. Russia, at the other extreme of fiscal policy, aiming at nothing short of the prohibition of foreign trade, finds her markets depressed and her treasury depleted. The oblique form of protection known as the bounty system has been tried with results which, as traced by Mr. Wells, must have surprised the experimentalists. France and Germany, in artificially stimulating the production of beet-root sugar, have only succeeded in taxing themselves heavily to provide their chief rival in manufactures, Great Britain, with an important raw material at less than cost. The British industry in jam and sweets, expanded by cheap sugar, now employs more people than those needed to refine the sugar consumed.

The general fall in prices during the recent past has been a source of much embarrassment and perplexity in the world of commerce. Among the theories proffered in its explanation that of the bimetallists has been prominent, and Mr. Wells riddles it thoroughly. He shows that whereas the cost in labor of producing gold has varied but little for ages, silver during this generation has been discovered in prodigious deposits; therefore any legislative attempt to maintain a hard-and-fast relation between the values of gold and silver must be vain. He points out that the gold reserves in the banks of the world are to-day, proportionately to capital, larger than ever. Furthermore, that the demand for gold constantly diminishes as banking facilities overspread the world with their telegraphic transfers, clearing-houses, and other devices for the economy of coin. But if it be demurred, Does not a debt incurred, say, ten years ago, require to-day more wheat or iron for its satisfaction than the sum could have bought when first borrowed? Certainly, but the wheat or iron represents no more labor now than it did ten years ago, and its increase in quantity stands for the new efficiency which applied science has bestowed on toil. Let the fall in the rate of interest be noted as evidence that, among sufferers from reduced pay, capital ranks as chief.

In every page, whether considering the eight-hour movement, the transportation problem, the gigantic cost of protecting American iron and steel for a decade, or any other of the manifold lines of his inquiry, Mr. Wells's analysis is transparent and impartial. In tracing the bearing of economic development on the welfare of man he rises by breadth of mind and sympathy to the dignity of a philosopher.

A POPULAR TREATISE ON THE WINDS. BY WILLIAM FERREL, Ph. D., late Professor and Assistant in the Signal Service. New York: John Wiley & Sons. Pp. 505. Price, $4.

SEVERAL essays bearing upon the mechanics of the atmosphere have been published by Prof. Ferrel at various times since 1856, but, as they were of a very mathematical character, they were adapted only to those well-trained in mathematics. The present volume is of a more popular nature, although the simpler mathematical operations involved in the presentation of the subject are retained. After a general description of the constitution and nature of the atmosphere, the effect of the earth's rotation in the dynamics of the atmosphere is explained, the general circulation of the atmosphere is described, and its climatic influences are pointed out. This circulation is shown to agree with the laws governing the movements of gases and vapors acted upon by heat and other forces. The rest of the volume is devoted to descriptions of the various kinds of winds, monsoons, land and sea breezes, cyclones of several varieties, and tornadoes, and explanations of their special causes. Thunder-storms water-spouts, hail-storms, and cloud-bursts, with various other allied phenomena, are also explained. The author offers his book to general readers interested in the subject, and to lecturers on meteorological subjects before college classes or other audiences.

European Schools. By L. R. Klemm, Ph. D. International Education Series, Vol. XII. New York: D. Appleton & Co. Pp. 419. Price, $2.

Rarely has a book for teachers appeared containing so much that can be used in the school-room. It is not a ponderous and repulsive budget of statistics of school attendance, examination marks, illiteracy, etc., with courses of study and descriptions of departmental machinery. It is an account of the notable features observed during a trip of nearly a year among the educational institutions of the continent of Europe, or, as the author describes it in his sub-title, "what I saw in the schools of Germany, France, Austria, and Switzerland." The first device described in the book is an expedient which was employed by a teacher in Hamburg, and is called by the author "a master stroke." A stupid boy could not see that the difference between plus six and minus ten is sixteen. The master explained the problem and illustrated it with marbles, but in vain. Finally, he cast his eyes about the room, and they fell upon the thermometer. In a moment he had this before the pupil's eyes, and readily made him comprehend that the difference between 6° above zero and 10° below zero is 16°. A box of movable letters, a board with a slit in it through which letters making words are shown, a scheme for ventilation, a mode of teaching home geography, and a sketch of an efficient city school system, follow within the compass of a few pages. Methods of teaching drawing in different schools are described in several parts of the volume, and singing, knowledge of nature, mensuration, and language are only a few of the subjects dealt with. A notable section is that devoted to "a separate school for dullards," an idea which started in Rhenish Prussia at Elberfeld and has spread to other cities. This is not a school for idiots, but is intended for those unfortunate children whose dullness acts as a drag on their classes and brings ridicule and discouragement upon themselves. Here they receive patient instruction, and learn much more than they could in schools adapted to brighter pupils, while the latter are freed from impediments to their progress. The account of girls' industrial education at Cologne, comprising knitting, crocheting, embroidery, weaving, sewing, lace-making, cutting out garments, mending and patching, and accompanied by drawing, will be found interesting and suggestive. It is impossible to mention here all the subjects touched upon in this book; they cover a wide range, and each is presented in sufficient detail to give a definite idea of the method employed. The style of the book is clear and enthusiastic; the language is simple and, in humorous passages, even colloquial. It is a very readable volume—one which the teacher can take up at odd moments even when tired, and study without a sense of laboring. A notable feature of it is its abundance of illustrations, there being five hundred and twenty-three figures showing drawing models and outlines, articles used in teaching, plans of school-buildings, maps made in teaching local geography, articles and patterns made in manual training schools, etc., etc.

The Journal of Physiology. Vol. X. Edited by Michael Foster, M. D., F. R. S. Cambridge (Eng.): Cambridge Scientific Instrument Company. Pp. 576. Thirty-three Plates. Price, $5 a volume.

There are two papers in this volume on "The Regulation of Respiration," by Henry Head. The first details experiments made to ascertain the effects on breathing produced by dividing the *vagi*, by altering the volume of the lungs, by artificial respiration, and other means. Many observations were also made on the forms which the apnœa pause produced by artificial respiration assumes under various conditions. Nine plates of curve tracings accompany this paper. The theoretical conclusions from these experiments are embodied in the second paper. C. A. MacMunn contributes an account of experiments from which he infers that "bilirubin and biliverdin are produced in the liver mainly from effete hæmoglobin; these are acted on in the small intestine by the digestive and putrefactive ferments, and some, at least, changed into simple metabolites like the urobilin-like substance of bile." Stercobilin, formed in the intestines from derivatives of bile and hæmatin, may be taken up and excreted in the urine as pathological urobilin. Some "Observations on Human Bile obtained from a Case of Biliary Fistula," by S. M. Copeman and W. B. Winston, appear in another number of this volume. Regarding "The Nature of Knee-jerk," W. P. Lombard maintains that the reflex theory readily explains the intimate dependence of the phenomenon upon the spinal cord, and that the time argument against it is inconclusive, owing to our meager knowledge of reflex times in general, while the peripheral theory is untenable. The third number of this volume is devoted to a paper on "The Relation between the Structure, Function, Distribution, and Origin of the Cranial Nerves; together with a Theory of the Origin of the Nervous System of Vertebrata," by W. H. Gaskell. It is accompanied by five plates. W. D. Halliburton contributes the results of chemical analysis of a number of specimens of cerebro-spinal fluid, and, together with W. M. Friend, the results of an examination of the stromata of the red corpuscles. A second paper on "The Electrical Organ of the Skate," by J. B. Sanderson and Francis Gotch, contains observations as to the nature of the normal reflex process by which the electric organ is discharged, and the measurement of the electromotive force of the response of the organ to a single excitation. J. N. Langley reports further investigations upon the salivary glands in two papers, one dealing with "The Physiology of the Salivary Secretion," the other with "The Histology of the Mucous Salivary Glands, and the Behavior of their Mucous Constituents." L. C. Woolbridge, in a brief paper entitled "The Coagulation Question," argues against certain views of Dr. Halliburton. W. H. White contributes "Further Observations on the Histology and Function of the Mammalian Sympathetic Ganglia," a previous paper having been published in No. 2, Vol. VIII of the "Journal." An extended paper on "The Innervation of the Renal Blood-Vessels," by J. Rose Bradford, deals with the courses of the vaso-constrictor and vaso-dilator fibers, with the phenomena following excitation of the splanchnic nerve and of the peripheral end of the divided vagus, also with the reflex phenomena of the renal vessels. T. W. Shore and H. L. Jones publish a description of "The Structure of the Vertebrate Liver," approaching their subject from the side of comparative anatomy. G. N. Stewart presents a detailed account of a research on "The Stimulation Effects in a Polarized Nerve during and after the Flow of the Polarizing Current." C. S. Sherrington and C. A. Ballance, in a paper on "Formation of Scar-Tissue," give the record of their investigation as to whether the colorless corpuscles of the blood are the source of the new tissue which the inflammatory process produces.

Hygiene and Public Health. By Louis C. Parkes, M. D. Philadelphia: P. Blakiston, Son & Co. Pp. 471. Price, $2.50.

Substantially the whole field of sanitary science is brought within a moderate compass in this book. Water, removal of refuse, ventilation, warming, lighting, climate, building-sites, food, exercise, and clothing, all receive due attention from the hygienic side. A chapter on the prevention of communicable diseases has been included, also one on vital statistics. The book is intended for both the physician and the layman. Its language is simple enough, so that no technical knowledge is needed to understand it, though there are some tests and calculations included which the average layman will not make use of for himself. Numerous examples and illustrations are introduced in order to assist the physician in his public health work. The author deems the chapter on the removal of refuse rather long in proportion to the book, but gives as his reason for going so much into detail that apparently trivial defects in house-drainage, which are liable to be overlooked without thorough knowledge, are often the cause of the most severe outbreaks of disease. The volume is lettered on the back, "Practical Hygiene, Parkes," but the intending buyer should not confuse the book with the "Manual of Practical Hygiene" by the late E. A. Parkes.

A First Book in American History. By Edward Eggleston. Illustrated. New York: D. Appleton & Co. Pp. 203. Price, 70 cents.

The story of America is told by Mr. Eggleston in this book in a simple and vivid style. The requirements that he has had in view while preparing it are that an elementary book must, for those whose school-life will be short, give the leading facts of the whole field to be studied, and must not force upon those who are to follow it with an advanced work matters which will have to be restudied later. Furthermore, a beginners' book ought, before all things else, to be interesting. "The main peculiarity of the present book," says the author, "is that it aims to teach children the history of the country by making them acquainted with some of the most illustrious actors in it. A child is interested, above all, in persons. Biography is for him the natural door into history. The order of events in a nation's life is somewhat above the reach of younger pupils, but the course of a human life and the personal achievements of an individual are intelligible and delightful." By this means, also, the young American gets distinct pictures of the careers of the great men of his country. It is easy, moreover, in a history of the biographical type, to adopt the modern style of describing the life of the people in former times, as well as the progress of public events. The author is convinced that the lamented lack of moral teaching in our schools can be largely supplied by the inspiring examples found in the careers of our great men. The author has availed himself abundantly of the aid of pictures in giving the pupil a vivid conception of the narrative. No precise mode of studying the book is prescribed, but brief suggestions for a topical recitation are appended to each lesson. The book is well adapted to be used as a class reader, and several school superintendents have already declared their intention of employing it in this way. The pictures are numerous and bear the signatures of some of the most eminent illustrators in America. The maps are bird's-eye views, and one, designed to show the territorial growth of the United States, has the successive additions of territory printed on successive pages, the blank parts of which are to be cut out.

CHEMISTRY: GENERAL, MEDICAL, AND PHARMACEUTICAL. By JOHN ATTFIELD, F. R. S., etc. Twelfth edition. Philadelphia: Lea Brothers & Co. Pp. 770. Price, $3.25.

THIS substantial volume is adapted to be the life-long companion of the pharmacist or physician—a manual of instruction in his student days and a work of reference in his business or professional practice. The author expressly disclaims the recognition of any such varieties of the science as medical and pharmaceutical chemistry, and uses these terms only to indicate that he illustrates the principles of chemistry by those facts of special interest to the followers of medicine and pharmacy. "From other chemical textbooks," he states in the preface, "it differs in three particulars: first, in the exclusion of matter relating to compounds which at present are only of interest to the scientific chemist; secondly, in containing more or less of the chemistry of every substance recognized officially or in general practice as a remedial agent; thirdly, in the paragraphs being so cast that the volume may be used as a guide in studying the science experimentally. The order of subjects is that which, in the author's opinion, best meets the requirements of medical and pharmaceutical students in Great Britain, Ireland, America, India, and the English colonies." A few leading properties of the elements are first given, some of the fundamental principles of the science are next stated, and then the properties and relations of the elements and the compound radicals are presented in detail, attention being directed to those qualities on which analysis and synthesis depend. The chemistry of the carbon compounds is next considered. Practical toxicology and the chemistry of morbid physiological products then receive attention. The concluding sections form a laboratory guide to the chemical and physical study of quantitative analysis. In the appendix is a long table of tests for impurities in medicinal preparations; also a short one of the saturating powers of acids and alkalies, designed for use in prescribing and dispensing. In his arrangement of the radicals, the author "has preferred to lead up to, rather than follow, scientific classification," for the reason that systems of classification give "undue prominence to one set of relations and undeserved obscurity to others." The metric system is alone used in the sections on quantitative analysis; in other parts of the volume avoirdupois weights and imperial measures are employed. Numerous etymological notes are scattered through the book. A list of questions follows each section. The present edition contains what alterations and additions have become necessary since the appearance of the eleventh in 1885. The work now includes the whole of the chemistry of the United States Pharmacopœia and nearly all that of the British and

Indian Pharmacopœias. The chief new feature is the extended section on organic chemistry. By means of the index of fifty-six pages all the information in this comprehensive volume is made readily accessible; eighty-eight cuts show the forms of apparatus needed for the operations described.

STRENGTH: HOW TO GET STRONG AND KEEP STRONG By RICHARD A. PROCTOR. London and New York: Longmans, Green & Co. Pp 178. Price, 75 cents.

THE scope of this book is well set forth in the following sentences from the introductory pages: "Men, and women too, though they may have no occasion to acquire skill in athletic exercises, have great occasion to possess sound bodies, unless they are passing absolutely useless lives, when they may do as they please so far as their value to the community is concerned. . . . I propose in this little treatise to show how, by devoting a few hours weekly to well-arranged exercises, this end can be attained. No violent exertions are necessary, no difficult feats need be attempted, no special form of exercise need occupy much of the time and attention." Successive chapters are devoted to the description of exercises, many without apparatus, the others with only simple appliances, adapted to the expansion of the chest, and to the development of the muscles of the chest, abdomen, loins, arms, and legs. There are also chapters on reducing fat, the adapting of exercise to advancing years and to weakness, some "notes on rowing," and directions for learning to swim. A comparison of "Nature's Waist and Fashion's" is included, to which a lady contributes her experience in discarding the corset and adopting the divided skirt. The volume is illustrated with figures of classic statuary and of gymnastic apparatus.

THE STORY OF THE BACTERIA. By T. MITCHELL PRUDDEN, A. M. New York: G. P. Putnam's Sons. Pp. 143. Price, 75 cents.

EVERYBODY has heard of bacteria; many with a conscientious desire to keep informed upon the progress of science have undertaken to read up about them; and a large proportion of these inquirers must have retreated baffled from the task. But if those who have been discouraged by the technicalities of the learned treatises on micro-organisms would still like to know what the bacteria are and do, and how they are cultivated and examined, they can find out very pleasantly by reading Dr. Prudden's simple and fascinating "Story of the Bacteria." The author describes the chief forms of bacteria, and several kinds which are curious from their color, power of emitting light, etc. He then tells how they act in producing surgical diseases, consumption, and typhoid fever, and what means are taken to repel their attacks. He also sets forth what is believed in regard to the relations of bacteria to Asiatic cholera, diphtheria, pneumonia, scarlet fever, etc.—diseases in which the action of the germs is less easily demonstrable. He points out, further, how impure food, air, water, and even ice may serve as sources of bacterial infection; and in conclusion gives the layman an intelligent view of the present standing of investigation in this field. This little book shows how perfectly a scientific subject may be freed from perplexing technicalities, and may well serve as a model of popular scientific writing.

According to the *Report of the Commissioner of Fish and Fisheries for 1886* (United States Fish Commission), the work of the year included explorations along the eastern coast of North America from the Straits of Florida to Newfoundland, in order to ascertain the winter range and habits of the mackerel, menhaden, blue-fish, and other important food fishes that resort to the eastern shores of the United States in the warmer months. Observations of the temperatures and densities of the water were made continuously at all the stations of the Commission, from the Commission's vessels, and at many light-houses and light-ships. The schooner Grampus, intended as a model for off-shore fishing smacks, and also containing a well for the conveyance of live fishes, was completed and added to the fleet of the Commission in this year. The distribution of the eggs and fry of food fishes was continued. The papers appended to the report comprise a comprehensive account of "The Sea Fisheries of Eastern North America," by the late commissioner, Spencer F. Baird; "A Review of the Flounders and Soles of America and Europe," by

David Starr Jordan and David Kop Goss; a review of the *Sciænidæ*, by Prof. Jordan and Carl H. Eigenmann; a paper on internal parasites of fishes, by Edwin Linton; and a report on *Medusæ*, by J. Walter Fewkes, all but the first of these being illustrated. A large number of reports from the vessels and stations of the Commission are printed, and the following papers from foreign sources are included in the volume: "On the Fish-cultural Establishments of Central Europe," by E. Bettoni and D. Vinciguerra; "Chemical Composition of Food Products," by P. Kostytscheff; "Cases of Poisoning caused by Spoiled Codfish," by Dr. E. Mauriac, and "Notes on the Norwegian Fisheries of 1885," by A. N. Kiaer. There is also a list of stations at which dredgings have been made in the Atlantic and Arctic Oceans from 1867 to 1887, by Sanderson Smith. The list is accompanied by five charts.

A translation of a series of essays by the Baroness *Marenholtz-Buelow*, setting forth Froebel's educational system, has been published under the title *The Child and Child-Nature* (Bardeen, $1.50). It describes the nature of the child, his needs, and the effects of training upon him. An account of Froebel's method is given, and this is followed by some of the exercises and translations of the songs which he devised for teaching the child's relations to nature, to mankind, and to God. A bibliography of Froebel is appended, and an index has been added to the American edition.

Dr. *R. von Krafft-Ebing's Experimental Study in the Domain of Hypnotism* has been translated into English by Charles G. Chaddock, M. D. (Putnam, $1.25). It is an account of a case which has excited much interest in Grätz, and comprises the preliminary history of the patient, a record of the course of her hystero-epileptic attacks, and a transcript from Prof. Krafft's daily notebook of hypnotic experiments upon her.

Evolution of the Electric Incandescent Lamp, by *F. L. Pope* (H. Cook, Elizabeth, N. J.), is a collection of extracts from records of courts and of the Patent-Office, newspaper files, and transactions of scientific societies bearing upon the question whether Edison or Sawyer and Man deserve the credit for the employing of a carbonized filament of organic material in the incandescent lamp. The book is illustrated with cuts of apparatus.

A beginner's text-book of *Iron and Steel Manufacture* has been prepared by *Arthur H. Hiorns* (Macmillan, $1), designed to give a knowledge of the principles underlying the processes of this industry. In the early chapters the substances used or produced in smelting are defined, the ores of iron are described, and the chemistry of the subject is explained. Then follow descriptions of the usual methods of extracting and refining the metal, and of the furnaces, hammers, and rolls employed in these operations. Iron casting, tinning, and galvanizing are also described. The processes in the production, tempering, and testing of steel are set forth in like manner. Questions are appended to each chapter for the use of students.

No. 96 of Van Nostrand's Science Series is on *Alternate-Current Machinery*, and comprises a paper read by *Gisbert Kapp* before the Institution of Civil Engineers, London, with the discussion upon it. Of the apparatus which may be properly included under his title, the author deals especially with alternators, transformers, and motors. The volume is illustrated with forty-three diagrams.

Since the first edition of the *Manual of Assaying Gold, Silver, Copper, and Lead Ores*, prepared by *Walter Lee Brown* (E. H. Sargent & Co., $2.50), was noticed in this magazine, the book has been increased from 318 to 487 pages. Other changes as given by the author are, "the stating of all charges in assay tons, grammes, and grains; detailed charges in the scorification process; full notes on the colors and appearances of the scorifiers (with a colored plate) and cupels after work; the expansion of the crucible process from *nine* to almost *ninety* pages; more complete articles on the assay of gold and silver bullion, and the volumetric analysis of copper ores; and, finally, the issuance of the book in flexible covers." The present (third) edition is but little changed from the second.

The little book by the late *Walter Bagehot*, embodying a *Plan for Assimilating the English and American Money*, first published in 1869, has been reissued in view of an expected revival of interest in the subject (Longmans, 75 cents). The author names, as trifling advantages of an international coinage, the convenience of travelers, facility in the exchange and transmission of coin, and in the comparison of monetary statistics. What he deems the one great advantage of such a money would consist in making identical the monetary language of the trade circulars of different nations. He believes that an international coinage should be founded on a single standard, have a high *gold unit*, have decimal divisions, and do no violence to national jealousies. Several international unit coins have been proposed—a twenty-five-franc piece, the English sovereign, a piece weighing ten grammes, and a ten-franc piece—but Mr. Bagehot points out objections to them all. The scheme which the author proposes is to unite the two great Anglo-Saxon nations upon a system of coins, by changing the sovereign from 960 to 1,000 farthings, or £1 0*s.* 10*d.*, which is almost identical with the American half-eagle. He believes that Germany and the Latin Union would in time adopt the Anglo-American money.

In his essay on *Involuntary Idleness*, read before the American Economic Association, and now published as a book (Lippincott, $1), the author, Mr. *Hugo Bilgram*, searches for the cause of lack of employment. He first examines the relation of capital and interest to labor, and obtains the inference that "a close relation exists between the economic cause of involuntary idleness and the law of interest." The author states that there is a tendency for the industrial class to drift into bankruptcy, and for money to accumulate in the hands of the financial class, thus depriving the channels of commerce of the needed medium of exchange, and causing stagnation of business and dearth of employment. The law of interest is then evolved by an analysis of the monetary circulation between the debtors and creditors. From this analysis is drawn the inference that "an expansion of the volume of money, by extending the issue of credit-money, will prevent business stagnation and involuntary idleness."

The Teacher's Manual of Geography, by *Jacques W. Redway* (Heath, 55 cents), consists of suggestions to teachers on out-of-door lessons for young pupils, the use of pictures and models, recitation, map-making, geodesy, hydrography, meteorology, history in geography, and boundary lines. Simple ideas of form, size, color, and locality are suggested to be presented to the youngest children in preliminary oral work. The tendency of the book throughout is to lead the teacher to give pupils a practical, comprehensible knowledge of the earth's surface, to correct popular errors, and to escape from traditional ruts. A list of books for geographical reading is appended.

A series of *Topics in Geography*, prepared by *W. F. Nichols*, for the use of his own schools, has now been published (Heath, 55 cents). The author states that his aim has been to make the study of geography more valuable, while shortening the time usually spent upon it. To this end he shows what to teach and what to omit, giving first a brief outline for a study of any continent based upon slope, and furnishing topics, to be taken up after this, which cover all that it is desirable to learn. Other features of his treatment are the sparing use of statistics, the combination of language with geography, and the making prominent of natural objects and wonders, which are always interesting to pupils. The course of study is graded. By permission, Prof. Redway's list of books for geographical reading is included.

The Nursery Lesson Book, by *Philip G. Hubert, Jr.* (Putnam, 75 cents), is designed as a guide for mothers in teaching young children. It comprises fifty lessons, each conveying simple and progressive instruction in reading, writing, arithmetic, drawing, and singing. It contains one hundred illustrations in outline and sixteen songs set to music. The page is large, the margins generous, and the general appearance of the book is attractive.

The life and labors of *Vitus Bering, the Discoverer of Bering Strait*, have been recorded in Danish by *Peter Lauridsen*, and an English translation by Prof. *Julius E. Olson* is now published (Griggs, $1.25). Bering was a Dane, who took to the sea in early life, and at the age of twenty-two joined a Russian fleet as a sub-lieutenant. This was during the period of Russia's rapid advancement under Peter the Great. In 1724 Bering, then a captain, was appointed chief of an expedition to determine whether Asia and America were connected by land. The expedition went overland through Siberia to Kamchatka, where ships were built and the explorations begun. Bering reached the strait that bears his name, and thus proved that Asia and America were separated by water. Soon after his return he proposed a second expedition to chart the northwestern coast of America, then an unknown land, and the northern coast of Siberia. This should lead to the establishment of trade with the American colonies, and also make known a way by water from Russia around to Japan. Bering reached the coast of Alaska in 1741, and died on the way back. For a long time jealousy discredited his results, and the chief object of the present volume is to establish the value of his discoveries. The book also tells the story of the obstacles which he overcame in his expeditions. It is accompanied by two folded maps, and has an introduction by Lieutenant Frederick Schwatka.

The literature of cycling has been increased by a book bearing the title *Cycling Art, Energy, and Locomotion*, written by *Robert P. Scott* (J. B. Lippincott Company, $2). It is largely devoted to explaining the mechanical principles involved in the action of the cranks, wheels, springs, bearings, gears, etc. It includes also brief discussions of the injuries charged against cycling, the bicycle for ladies, English and American workmanship in cycles, aluminum in cycle construction, and the application of steam and electricity to cycles. A second part of the volume comprises extracts from the patent specifications of a large number of velocipedes, cycles, and nondescript vehicles, with the inventors' drawings of the machines and riders, and humorous comments by the author. Many of these machines are astonishing contrivances, and perhaps none more so than the flying-machine, patented March 5, 1889, which is introduced at the end.

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Adams, Myron. The Continuous Creation. Boston and New York: Houghton, Mifflin & Co. Pp. 259. $1.50.

Barnard, Charles, and Woodhull, John F. Graphic Methods in Teaching. New York: College for the Training of Teachers (Educational Monographs). Pp. 32. $1 a year.

Boston Society of Natural History. Proceedings, Vol. XXIV, May, 1888, to May, 1889. Pp. 256.

Barnes, A. S., & Co.: New York and Chicago. List of Standard Works on Botany and Catalogue of New and Revised Educational Works.

Becker, George F. Geology of the Quicksilver Deposits of the Pacific Slope. Washington: Government Printing-Office. Pp. 486, with Map, and with an Atlas of fourteen sheets.

Bonwill, W. G. A. The Philosophy of Eating and Drinking, from a Medical and Dental Standpoint. Philadelphia. Pp. 21.

Chadwick, John W. Evolution as related to Religious Thought. Boston: The New Ideal Publishing Company. Pp. 24. 10 cts.

Cornell University College of Agriculture: Experiment Station. Bulletin. Tomatoes. Pp. 16.

Dabney, W. D. The Public Regulation of Railways. New York and London: G. P. Putnam's Sons. Pp. 281. $1.25.

Darby, John. Man and his World; or, the Oneness of Now and Eternity. Philadelphia: J. B. Lippincott Company. Pp. 259. $1.

Davis, Nathaniel E. Foods for the Fat. American edition, edited by C. W. Greene. Philadelphia: J. B. Lippincott Company. Pp. 138. 75 cents.

Davis, Walter G. Ligeros Apuntes sobre el Clima de la República Argentina (Notes on the Climate of the Argentine Republic). Buenos Ayres. Pp. 254, with Tables and Map.

Donisthorpe, Wordsworth. Individualism. A System of Politics. London and New York: Macmillan & Co. Pp. 393. $4.

Dunton, Larkin. The World and its People (Young Folks' Library, Vols. V and VI). Boston, New York, and Chicago: Silver, Burdett & Co. Two volumes. Pp. 160 and 159. 36 cents each.

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"Geographic Magazine, The National." Vol. I, No. 4, Washington, D. C.: The National Geographic Society. Pp. 60, with Maps. 50 cents.

Harrison, John Thornhill. On the Creation and Physical Structure of the Earth. London and New York: Longmans, Green & Co. Pp. 189.

Hubert, Philip G., Jr. Liberty and a Living. New York and London: G. P. Putnam's Sons. Pp. 239.

Keyes, Charles R. Johns Hopkins University. Lower Carbonic Gasteropoda from Burlington, Iowa. The American Species of Polyphemopsis Sphaerodoma; a Genus of Fossil Gasteropoda. Pp. 24.

Laing, Samuel. Problems of the Future; and Essays. London: Chapman & Hall. Pp. 469.

McCarthy, Gerald. Botany as a Disciplinary Study. Pp. 6.

McKendrick, John Gray. A Text-Book of Physiology. Vol. II. Special Physiology. New York: Macmillan & Co. Pp. 808. $6.

Massachusetts Agricultural Experiment Station. Bulletin No. 35. Meteorological Summary. Pp. 11.

Morgan, Thomas J. Studies in Pedagogy. Boston, New York, and Chicago: Silver, Burdett & Co. Pp. 355. $1.75.

Neal, J. C. The Root-Knot Disease of the Peach, Orange, and other Plants of Florida, due to the Work of Anguillula. Washington: Government Printing-Office. Pp. 30, with 21 Plates.

Newberry, John S. Fossil Fishes and Fossil Plants of the Triassic Rocks of New Jersey and the Connecticut Valley. Washington: Government Printing-Office. Pp. 95, with 26 Plates.

Nichols, Starr Hoyt. The Philosophy of Evolution. Boston: The New Ideal Publishing Company. Pp. 24. 10 cents.

Ohio Agricultural Experiment Station, Columbus. Bulletin, September, 1889. Five articles on Insects and Potato-rot. Pp. 28.

Oliver, Charles A., M. D., Philadelphia. Description of a Case of Embolism of the Left Central Retinal Artery. Pp. 5.

Platt, James. Money. New York and London: G. P. Putnam's Sons. Pp. 267. 75 cents.

Pope, Colonel Albert A., Boston. Highway Improvement. Pp. 18.

Roberts, John B., Philadelphia. The Cure of Crooked and Otherwise Deformed Noses. Pp. 24. —Delusions in Eye-Surgery. Pp. 8.

Rothschild, M. D. A Handbook of Precious Stones. New York and London; G. P. Putnam's Sons. Pp. 143. $1.

Savage, Minot J. The Effects of Evolution on the Coming Civilization. Boston: The New Ideal Publishing Company. Pp. 24. 10 cents.

Storrs Agricultural Experiment Station, Mansfield, Conn. Bulletin No. 5. Atmospheric Nitrogen as Plant Food. Pp. 19.

Stroud, William L., Editor. "Eusebia: A Monthly Journal for Bible Students." Oakland, Cal: L. F. Cockroft. Pp. 14. $1 a year.

Taylor, John W., Joliet, Ill. Cause and Effect inherent in the Heavenly Substance. Pp. 59.

Thackeray, S. W. The Land and the Community. New York: D. Appleton & Co. Pp. 223. $1.

United States Geological Survey, Bulletins. No. 48. On the Form and Position of the Sea-Level. By R. S. Woodward. Pp. 88. 10 cents.—No. 49. Latitudes and Longitudes of Certain Points in Missouri, Kansas, and New Mexico. By R. S. Woodward. Pp. 133. 15 cents.—No. 50. Formulas and Tables to facilitate the Construction and Use of Maps. By R. S. Woodward. Pp. 124. 15 cents. —No. 51. On Invertebrate Fossils from the Pacific Coast. By C. A. White. Pp. 102, with 14 Plates. 15 cents.—No. 52. Sub-aërial Decay of Rocks, and Origin of the Red Color of Certain Formations. By I. C. Russell. Pp. 65, with Five Plates. 10 cents. —No. 58. The Geology of Nantucket. By N. S. Shaler. Pp. 55, with Ten Plates. 10 cents.

Waller, E., Ph. D. Notes on the Analysis of Zinc Ores. Pp. 5.

Ward, H. Marshall. Timber and some of its Diseases. London and New York: Macmillan & Co. Pp. 295. $1.75.

Whitman, C. O. "Journal of Morphology." September, 1889. Boston: Ginn & Co. Pp. 148.

Wood, Alphonso. Lessons on the Structure, Life, and Growth of Plants. Revised and edited by Oliver R. Willis. New York and Chicago: A. S. Barnes & Co. Pp. 220. $1.

POPULAR MISCELLANY.

The American Forestry Association.—The American Forestry Congress at its eighth annual meeting, held in Philadelphia in October, changed its name to Association. The meeting was opened with an address by the Hon. Carl Schurz, in which he narrated the difficulties he encountered from the opposition of Congressmen when, as Secretary of the Interior, he endeavored to protect the forests on the public lands against timber thieves. Mr. B. E. Fernow spoke on "Methods of Forestry Reform," and particularly of what lay within the competency of the Government. Resolutions offered by Mr. Fernow, recommending the withdrawal of all public forest-lands from sale till a permanent system of national forest management can be applied, called out debate. Mr. L. Thompson, a lumberman, argued that it would be contrary to our national usage and the spirit of our institutions to extend the sphere of Government control over interests that have been hitherto successfully managed by private enterprise; that the forests would be better protected by selling the land to citizens than by putting them under the management of office-seekers and politicians. Colonel Edgar T. Ensign held that where large watersheds are involved, and the streams are to be used for irrigation, only national control can be made efficient and adequate; that it is not enough even to leave the matter to individual States. Mr. Richard J. Hinton pointed out the impossibility of adequate supervision by owners or individual States of rivers like those that have their sources in our Western mountain forests. Mr. Fernow's resolutions were adopted. A resolution in favor of removing the duty on lumber was not entertained, for fear of drawing the Association into political controversies.

Lake Ridges of Ohio.—In the American Association paper of the Rev. G. Frederick Wright on "The Relation of Lake Ridges in New York, Ohio, and Ontario," the ridges in Ohio were described as being four in number, and standing at elevations above the sea of 775, 720, 690, and 650 feet. They consist of sand and gravel piled up to the height of from five to twenty-five feet, and approximately parallel with Lakes Erie and Ontario, and are evidently old shore lines of the lakes. The problem of how the water could have been kept up to these several levels seems to have been solved with considerable probability by recent glacial investigations. Attention was called to the fact that the irregularities of the southern boundary of the glacial region are such that if the retreat of the ice front was with equal rapidity all along its course it would have wholly withdrawn from Lake Erie and western Lake Ontario some time before the ice-dams across the Mohawk and the St. Lawrence had been melted away. An inspection of the map shows that two of the most important of these outlets would be, (1) that through Seneca Lake into the Chemung River in New York, and so into the Susquehanna, and (2) that through the Wabash at Fort Wayne, Ind. The heights correspond pretty well with that of the upper and third ridges in Ohio, the upper ridge being probably connected with the Chemung River outlet, and the third with the Wabash outlet.

Favoritism at Trinity House.—Prof. Tyndall published a full account, in the "Fortnightly Review" some months ago, of the transactions that led him, in 1883, to resign his position as scientific adviser to the Trinity House. The case, according to his showing, was one of the persistent exercise of personal and political favoritism by the Board of Trade in the experiments for determining what were the best lights for lighthouse purposes. In the competition between the quadriform gas-light of Mr. Wigham, a Scotch Irishman, who had the misfortune to be in trade, and the eight-wick oil-lamp of Mr. Douglass, whose brother was connected with Trinity House, the conditions were arranged so as to be more favorable to the latter. The electric light was then introduced into the competitions, and the proposition gradually assumed a form indicating a disposition to crowd Mr. Wickham out; so that Prof. Tyndall came to the conclusion that "if the treatment of the gas invention and its optical adjuncts could be regarded as a fair sample of the treatment of Ireland by England, it would be the bounden duty of every Irishman to become a Home-Ruler." The evidences of partiality becoming more and more prominent in the action of the board and its committee, Prof. Tyndall felt constrained to resign. Two months afterward the committee went to pieces. Prof. Tyndall observes that some of the parties throughout the transactions seemed to think that Ireland, and not the ships of all nations sailing to its coasts, was the chief beneficiary from the lighthouses.

Interesting Fossils of British North America.—The Cretaceous fossil plants of Port McNeill, Vancouver Island, as described by Sir William and G. M. Dawson, consist chiefly of dicotyledonous leaves, with a few fruits. Large slabs have been procured, some with perfect specimens of the leaves. There are no ferns or cycads in the collection, and conifers are rare. Among the latter are two species of *Salisburia*, or gingko, one of which is "a beautiful little form." The exogenous leaves are very numerous, and belong to a number of genera, with at least twenty species, giving evidence of a very rich and varied forest flora of warm temperate aspect. Sir William Dawson has made an interesting study of the *Balanus hameri* of the Pleistocene of Rivière Beaudette, a species which is still living in somewhat deep water on the Canadian coasts. The specimens under consideration were found farther west than any point at which the fossil had been previously observed, and are interesting from their remarkable perfection and the large masses which they form. The original attachments of the animals, so far as observed, were on pebbles on the surface of the clay, and, as these afforded space for only one or two individuals, the young were obliged to attach themselves to the old in successive generations. Most grotesque groups were thus formed, which still remain entire. Observations of peculiar varieties of the mussels *Mya arenaria* and *Mya truncata* in the modern sea and in the Pleistocene have led the same author to remark upon the interesting feature of "the companionship of these allied species in the North Atlantic throughout the Pleistocene and modern periods, and their range of varietal forms applicable to each, according to the conditions to which they have been exposed, along with their continued specific distinctness, and the preference of each for certain kinds of environment; so that in some places one and in others the other predominates, while this relative predominance, as well as the prevalence of certain varietal forms, might no doubt be reversed by change of climate or depth."

The Cretaceous Inland Sea.—In the course of two years' study of the northern and eastern terminations of the Texas Cretaceous deposits, Prof. Robert T. Hill has found that the marine sedimentation of both divisions of the formation was limited on the north by an older continental shore line, the present remnant of which extends from the Ouachita River, near Malvern and Hot Springs, Arkansas, almost due west through Indian Territory into the Panhandle of Texas. The whole Cretaceous history, including the upper and lower systems, can be summed up as two profound subsidences, separated by a land epoch, which have left in their sediments two great chalk formations. During the second subsidence, which was the deepest in all Mesozoic times, the Atlantic Ocean extended continuously from British America southward around the Appalachian continent. Prof. Hill has begun the publication of a series of illustrations of the paleontology of the Cretaceous formations of Texas, in which pictures and outlines of characteristic fossils are given, with letter-press descriptions. The first number thus represents *Pecten* (*Vola?*) *Roemeri Peterocera Shumardi*, and *Crioceras?* (*Acaylocera*s) *Texanus*—all new species, of the Comanche series, or Lower Cretaceous.

An Orthodox Compliment to Darwin.—The first number of the "Cumberland Presbyterian Review" (Nashville, Tenn., January, 1889) contains a broad and enlightened article on "Charles Darwin," by Prof. J. I. D. Hinds. The author, whom the company in which he appears attests to be orthodox, looks at Darwin's doctrines on their merits, without regarding their seeming bearing on questions that are equally liable to be misunderstood with those with which the theory of evolution deals. "When a man wins distinction in this world," he begins, "it is customary to condemn him outright if his teaching happen to be in conflict with the consensus of mankind. This is natural, but at the same time very unwise; since it has thus often happened that theories have been placed under the ban which have afterward been proved true. . . . If Darwin found the correct explanation of the phenomena of the organic world, his theory will stand the test of investigation and logic; if not, it must take its place with other theories which have served their day, and have yielded to better ones; she must be content to leave the decision to the scientist and the philosopher, and we can certainly have no reason to reject their final conclusion. . . . The Christian, of all men, should have the greatest confidence and repose of mind in the face of the investigations of the present day: for, if his religion be true, its foundations can not be shaken; and, if it be false, he has nothing to lose." Of Darwin's theory, undoubtedly its first tendency "is toward infidelity and skepticism. But since the world has become familiar with it, and has found that it is simply an attempted explanation of the ordinary course of nature, to be placed side by side with Newton's law of gravitation, Copernicus's theory of the solar system, the nebular hypothesis, and the geological eras of indefinite time, it has ceased to be atheistic, and is likely soon to become itself one of the arguments of natural theologians." Of Darwin's agnosticism, "his religious views and the changes through which they passed were but the natural outcome of the course of his investigations and studies. He was a pioneer, and could not see the true ethical import of the doctrine which he promulgated. Like many other investigators, he contrasted the ideal of God to which his theories led him with theological dogmas and the prevalent anthropomorphic conceptions of Deity. His training had been Calvinistic, and the freedom which he found everywhere in nature did not accord with the Calvinistic idea of fatality and the arbitrary action of the supernatural will." Finally, "In truth, let me ask, how much worse is it to have pithecoid ancestors than to be a beast in *propria persona?* The great question with us is, not whence we came, but what we are, what we should be, and what we are destined to be."

The Moving Forces of Meteorite Swarms.—An attempt has been made by Mr. G. H. Darwin to apply the kinetic theory of gases to the case of a swarm of meteorites in space. The individual meteorites are analogous to the molecules of the gas, and the mass of gas corresponds, in the author's theory, to the whole solar system. Lockyer and Sir William Thomson have expressed their conviction that the present condition of the solar system is derived from an accretion of meteorites, but the idea of fluid pressure seems necessary in explaining present forms of equilibrium. The author proposes to reconcile the two theories by showing that the laws of fluid pressure apply to a swarm of meteorites which is condensing to a solid form. The case of an infinite atmosphere of equal-sized meteorites is considered, and then the case of meteorites of very different sizes. In the case of a swarm of meteorites condensing under the mutual attractions of its parts, the author shows that the larger meteorites will gravitate toward the center of condensation, and that consequently the mean density of the condensed mass will decrease from the center toward the circumference. During the process of condensation the condensing mass will first gain by accretion of meteorites; then a balance will be maintained between those which remain on the condensing mass and those which rebound from it; and, finally, more will be lost by rebounding than gained by accretion.

The Sacred Maori Axe.—The thought of a connection between ancient stone weapons and thunder is widely diffused, and has a hold even in European minds. A curious illustration of its character has been communicated to "Nature" by Mr. Edward Tregear, of Wellington, New Zealand., in the shape of a translation from a Maori newspaper of the story of the finding of the sacred axe, Te Anhiorangi, which had been hidden by a remote ancestor, and had not been seen again till December, 1887. A party of Maoris had gone out to gather the edible mushroom. With them was a young woman, a stranger in the district, and ignorant of the sacred places. Wandering away by herself, and looking here and there for funguses, "she saw a tree on which there was a fungus, and laid her hand on it, but suddenly there came the flash of the axe. Following with her eyes the direction of the flash, she saw the axe close against the foot of a pukatea-tree; a cry of terror broke from her, and she fled screaming. At the same time the thunder roared, the lightning flashed, and blinding hail burst forth in sudden storm, increasing her terror almost to madness. Her husband heard her cries as she flew along; but an old man, called Te Rangi Whakairione, directly he heard her shrieks, understood the reason of the outcry, so he began to chant an incantation, and the fury of the storm abated. When the party had assembled in the open land, the old priest asked which of them had been to Tieke; whereupon the girl asked, 'Where is Tieke?' The old man answered that it was beyond the turn at Waione. Tomairangi replied: 'I have been there, but I did not know it was a sacred place; I saw something that looked like a spirit, and I am full of great fear.' Then all the party went to ascertain what it was, and then they found that it was indeed the lost sacred axe, Te Anhiorangi. After Te Rangi Whakairione had chanted another incantation over it, they all took hold of the axe, and wailed over it. When the crying had ceased, they brought the axe back to the settlement." The tradition had long existed that the axe was at the spot where it was found, which had therefore been tabooed, and never visited until on this occasion. On the next day the sacred thing was hung up on a tree, that all might see it, with imposing ceremonies of a procession and priests reciting charms and incantations. "All the people carried green branches in their hands as an offering to Te Anhiorangi. When the concourse drew near the place, successive peals of thunder and flashes of lightning rent the air; then came down a dense fog, making it dark as night. The Tohunga (priests) stopped the thunder and dispersed the darkness by their incantations. When the light again appeared, the people offered the green branches, together with a number of Maori mats, etc.; then they made lamentations, and sang the old songs in which the ancient axe was spoken of by their forefathers. The pedigree of the axe, which was a stone weapon of extremely high polish, was traced back to the first Maori chief who came to New Zealand; and to him it had descended, through the great god, Tane, from the primeval pair, Heaven and Earth.

Remedies for Sleeplessness.—Correspondents of the London "Spectator" have been supplying that journal with various remedies for sleeplessness. A curate in London is afflicted in direct proportion to the mental worry and absence of air and exercise he has to endure, and finds that "to walk even one mile in the day is a great thing" in the way of a remedy. At the moment, he says, the best thing one can do is to get up, drink half a glass of water, and walk round the room. The slight alternation of cold and warmth has a soporific effect. For a permanent result: "Live healthily. Avoid too little and too much exercise, food, particularly wine. Dine lightly, eating very little meat; drink only one glass of wine. Bathe an hour before dinner, not before going to bed. . . . Do something in the evening that does not excite you, something like whist that does itself mechanically. Decide how much sleep you ought to have—say, eight hours—and get up sternly when you have been in bed eight hours, however long you have been awake. Increase your air and exercise gradually." A journalist, when suffering from an over-excited brain, and finding his eyes in constant movement, although the lids are closed, resolutely fixes the gaze downward—say, to the foot of the bed—while the lids are kept closed. If his sleeplessness arises from flatulence, he takes a remedy for that. "A most wretched lier-awake" of thirty-five years' standing, who had for ten years thought himself happy if he could get twenty minutes' sleep in the twenty-four hours, took hot water—"a pint, comfortably hot, one good hour before each of my three meals, and one the last thing at night—naturally, unmixed with anything else. The very first night I slept for three hours on end, turned round, and slept again till morning. I have faithfully and regularly continued the hot water, and have never had one 'bad night' since. Pain gradually lessened, and went; the shattered nerves became calm and strong, and instead of each night being one long misery spent in wearying for the morning, they are all too short for the sweet, refreshing sleep I now enjoy."

The Mental Torpor Remedy.—Complete intellectual torpor is recommended as a remedy for overweariness by a writer who, to sustain his view, brings pertinent illustration to the support of argument. Such a condition is almost superstitiously avoided by hard-working men, who are disposed to regard it as a waste and an idle indulgence. But "there is no more harm in intellectual torpor for the sake of the mind's health, than in sleep for the sake of the body's health; and its duration ought to be governed only by expediency. . . . As to the curative effect of torpor, we have no doubt whatever. So far from the mind being weakened by total rest, or the energies diminished, both wake after a time fully recovered, and repossessed of the old readiness to exert themselves to fatigue. 'I am tired,' says the cured man to himself, 'of doing nothing'—that is, he has recovered the power to do things easily, which is the mark of mental health. The mind itself is, in fact, often positively stronger, having grown in its sleep as the body grows, and having, so to speak, resharpened its weapons, till the 'lazy' mathematician can not only solve his old problems more quickly, but can recollect them more accurately, the mind having gained, as in boyhood it gained, from sleep. We can all recollect how in school-days the lesson of the evening was often best known on the following morning, although, if torpor weakens, we ought in the intervening twelve hours to have invariably lost some slight grip of the words, instead of gaining a fresh one. The memory in particular recovers under this process in the most amazing way, so that even the permanent weakness, the slowness of recollection which comes of advancing years, seems to disappear. The grand gain, however, is in mental nerve, in the disappearance of that apprehensive anxiety and sense, not of strain which is, but of strain which is coming, that, far more than actual toil, however severe, shatters men's powers to pieces. But how is torpor to be attained? Like everything else, by determining to have it—that is, by a persistent resolve to be lazy, to do nothing, read nothing, think nothing, and say nothing, that involves the smallest upspringing of the sense either of trouble or of effort."

Animal Language.—Whether animals can "talk," and men can learn to understand their "language," is the subject of an article by Mr. F. G. Frazer in the "Archæological Review." A critic of the paper denies the human part in the matter, and declares that the supposition that men can learn to understand animals to the extent implied "is a direct contradiction to universal and unbroken human experience." All representations asserting such an achievement as a fact, or assuming its possibility, are vain boastings or imaginings. Yet beasts and birds all utter sounds, and sounds that have meaning to them, and meanings which to a certain extent we can understand. "They all utter, or at least they all seem to utter, the same sounds to express the same emotions. The love-cry of the nightingale, the low by which a cow recalls a straying calf, the grunt of a pig when it sees food, the mew of a cat who wants the door opened—that is, wants to attract attention—the bark of a domesticated dog to testify recognition, and the howl of an uncivilized dog as the moon rises, or of a civilized dog when the church-bells begin, are all, to human ears at least, unchanging sounds, sounds with one meaning and no other." So with numerous other familiar sounds peculiar to certain animals, and well understood; but they can not be regarded as "language" in the sense in which the term is used in the proposition under review. An interesting detail of the discussion concerns the grating sound—not unlike the "gnashing of teeth"—of the scolding or "swearing" of birds, which they utter also evidently in play—as kittens and dogs are also fond of playing bite, and dogs bark. However much there may be that one can not learn of the "language of animals," the study of the little that is at our command is enough to furnish profitable as well as amusing occupation.

A Glance at Cambodia.—A French traveler, writing from Penompein, the capital of Cambodia, says that "in passing from Cochin China to Cambodia, the difference between the Cambodian and the Annamite type is very striking. The Cambodian is almost the height of Europeans, and is idle and dirty, while the Annamite is small and active. A full-grown Annamite woman is like a French girl of twelve. A book on Cambodia would be very interesting. The banks of the river are covered with luxuriant vegetation. The entire territory and its inhabitants belong absolutely to the king, who lives here, with a second and third king besides him, while a fourth king is stationed in the interior. He has three hundred wives, chosen from the handsomest women in the whole country. The second king at present is in opposition to King Merodom. All the Cambodians are the king's carmen or slaves, and pay him rent. . . . The country is a most curious one. Elephants are very numerous here, and wander about in freedom through the brushwood, like oxen in the meadows of France. The capital of Cambodia consists of only one street, which is nearly four miles long. In all the town there are not ten houses built of stone or of bricks, and those so built are public buildings. All the officers are lodged together in two *pagothes*, which are almost contiguous. A *pagothe* is composed of a wooden floor resting in turn on a scaffolding of bamboo. The walls are formed of a trellis of straw or leaves, in the style of the thatch of cottages all over Europe. If you push with your finger a little strongly, it will pass through the wall. The roof is of thatch. The furniture is very primitive. It consists of a bed, formed of a frame in bamboo on which is placed a mat, and a table."

Stages of Himalayan Vegetation.—General R. Strachey describes the changes which the traveler meets in ascending one of the great mountain-ranges, as embodying a compendium of the climates and vegetation of the entire globe. Nowhere can such a display be better or more easily obtained than upon the Himalayas. The transition is abrupt from the well-cultivated plain of northern India, with its fields of rice and millet, or golden-flowering mustard, to the dense, umbrageous forests along their base, almost wholly composed of trees of tropical forms, with a few oaks and an elm, which, with a tangled growth of undershrubs and creepers and epiphytal plants, give cover to the elephant, the rhinoceros, and tiger, and afford shelter to the peacock and other gayly colored birds. The glens are choked with gigantic grasses and feathering bamboos. Great forests cover the outer ranges of the chain, scandent palms spreading over the lofty trees, whose stems are splendidly furnished with the dark-green foliage of climbing aroids; the ground beneath them is concealed under a rich growth of tree and other ferns, orchids, and *Scitamineæ*, or broad-leaved plantains. With gradually increasing elevation and falling temperature the character of the vegetation changes. More open woods of evergreen trees, typical of warm temperate climates, succeed, including rhododendrons, oaks, and laurels. Lofty pines cover the vast mountain-slopes through many thousand feet of altitude in unbroken uniformity. Still ascending, are reached forests of deciduous trees of surpassing size and beauty, crowning the hill-tops and fringing the courses of the rivers, intermingled with many flowering shrubs and an abundant display of herbaceous plants, of which, at the greater elevations, the forms are for the most part allied to or identical with those of Europe. The arboreous vegetation, the last members of which are commonly birches, pines, and junipers, usually ends at about twelve or thirteen thousand feet above the sea-level, the shrubby growths ascending a thousand feet higher. The Alpine region is thus attained, where, under the influence of the frequent showers that fall upon the mountain-slopes exposed to the south, the open pastures are adorned, during their short summer, with flowers of every hue and in the greatest profusion and luxuriance, including well-known European forms, such as gentian, primula, anemone, ranunculus, and many others. With increased elevation, and as the ranges are less directly exposed to the rain-bearing winds from the south, the climate becomes colder and drier, the vegetation more scanty, the forms fewer; and on reaching the border of Thibet, at an elevation of fourteen or fifteen thousand feet, where the atmospheric conditions are wholly changed, the aspect of the country is that of a desert—treeless and bare, as a rule—and, excepting in the rare neighborhood of water, not one twentieth of the surface is clothed with vegetation, and such bushes as there are seldom rise to a greater height than one or two feet.

Experimental Fields at Rothamstead.—The grass-land experimental field at Rothamstead consists of about seven acres, and is divided into twenty plots. It has probably been laid down in grass for some centuries. It is certain that no fresh seed has been artificially sown within the last fifty years; and there is no record of any having been sown since the grass was first laid down. The experiments were begun in 1856, when the herbage was uniform in character. Each plot has been treated differently. One has had no manure, others have had farm-yard dung, superphosphate of lime, ammonia salts, sulphate of potash, or other chemicals. Sir John Lawes said to a writer in the "Pall Mall Gazette," who visited the farm, that "the result was evident in many ways. On one plot the fertilizers supplied had fed only a single kind of grass, which had covered the whole area, killing out all the rest. On another the grass was hard and wiry, scarcely fit for food; and on yet another the land was little better than a bog. We can not go into technical details as to the results, but these experiments have shown that the food which plants receive, either artificially from the soil, or by the atmosphere, determines their nature as much as in the case of animals. The same thing is seen in the wheat and barley fields. One of the most important of the former is a section upon which the grain has been grown continuously for forty-five years, in one case without manure. The average of the first recorded eighteen years gave 14⅞ bushels per acre, and last year the same quantity was produced, showing that in the soil there is a large reserve amount of fertility." In another part of the field, Sir John Lawes told the writer: "Five years ago we left the upper end of this wheat-field uncropped, allowing the corn to fall when ripe. In three years there was scarcely a single ear of corn left; those which I could find were short in the stalk, and with perhaps a single grain. Now there is not one. This shows that food-products are almost entirely artificial, and that in a few years the land would be a perfect wilderness, if uncultivated. But I myself was surprised at the rapidity with which the wheat disappeared." This was explained thus: "The weeds were stronger, and killed out the artificial grain. Weeds are hardy, and it is really 'the survival of the fittest' or the hardiest. The same thing I can show you in the turnip-field, where the unmanured plot is almost barren, the plants having scarcely in any case formed a bulb. It is the starch we want as food. Cultivation and fertilization give that starch."

Palm-Oil.—Palm-oil is the product of the fruit of the oil-palm tree of Guinea. The fruit grows in clusters on top of the tree, which is about thirty feet high, and resembles a chestnut. The oil is extracted by boiling the pulpy and fibrous mass around the central nut, and is used in making soap and candles. The fruits are harvested in April. The oil of *Arachis*, which is equally important in commerce, is from the nut of the *Arachis* (peanut), thousands of tons of which are sent to Europe every year to be made up into "olive-oil." It is the fruit of an annual creeping plant (*Arachis hypogea*), and ripens in July and August. Oils of inferior quality are made into soap. Another underground nut (*Voandzeia subterranea*) affords a white, hard butter, richer than butter from the cow, which has the further advantage of remaining fresh for a whole year without being salted. Only limited quantities of this product have as yet come into the market. The native Africans use all these fruits, under one form or another, for their own alimentation.

Flowers and Perfumes.—The rose is extensively cultivated in the Balkan Peninsula, chiefly for the sake of the perfume it affords. The Provence or cabbage rose, it is said, will yield in the second year from one hundred to two hundred bushels of flowers per acre, weighing six pounds to the bushel. The rose harvest at Adrianople sometimes yields about ninety-four thousand ounces of attar of roses; the average of the Bulgarian harvests in the past ten seasons has been fifty-seven thousand ounces. The price of this perfume has declined fifty per cent since 1883. The Moors in Algeria extract an attar of moderate value from the indigenous double white musk rose. Twenty-eight tons of rose-leaves were imported into Aden in 1886, of which half were shipped to India. The "ixora extract" is made from the soka-flower (*Parvelta angustiflora*); frangipanni, from the flowers of species of *Plumeria*, native to the West Indies and some parts of South America; the essence and pomade of *cassie*, of the French perfumers, from the flowers of *Acacia farnesicina*. About one hundred tons of these flowers are used in Cannes yearly, individual makers working up one hundred thousand pounds. The fragrant white flowers of *Blighia sapida* and of the Bukul (*Mimusops Elengi*) are used for making distilled waters; and the flowers of spikenard (*Andropogon nardus*) are employed in Algeria for perfuming hair-oils and cosmetics. Moorish women form garlands to ornament the interior of their dwellings from the flowers of the jasmine, and obtain a perfume by steeping them with oil in bottles, which are exposed to the sun. The same process is applied to the flowers of the tuberose and the cassia. Hungary water is distilled with spirit from the tops of rosemary-flowers. Twenty tons of violets are used annually in Nice and Cannes, and one hundred and twenty tons of orange-blossoms in Nice. Orange-flower water is one of the most agreeable vehicles for nauseous medicines that we have. Rose-buds are made into preserves in Arabia; the blossoms of the shaddock are used for flavoring sweetmeats, and the fleshy calyces or flower-bracts of the Indian sorrel, a *Hibiscus*, having a pleasant acid taste, are made into tarts, jellies, and refreshing drinks in India. The petals of flowers are much used in Roumania for flavoring preserves, of which not less than one hundred and fifty varieties are made.

NOTES.

Attention has been called, in letters written by Mr. James R. Skilton to the Mayor of Brooklyn, to the dangers that are hidden in the pipes through which water-gas is conveyed into houses and in the meters. The pipes and the meters are often—it would hardly be too much to say, usually—leaky, and as the escaping gas, largely carbonic oxide, while extremely poisonous, is imperceptible to the senses, great harm may be and often is wrought before the family are aware that anything is wrong. It is hard, even when the nuisance is known to exist, to force timely attention from the companies furnishing the gas, and, when they do send men to make repairs, the work is, as a rule, done in the most negligent manner. Mr. Skilton has no doubt that "hundreds of people are sacrificed every year to the Moloch of the gas-meter."

In the "Monthly" for July there is a note in which Asamayama is spoken of as the highest active volcano in Japan. This is popularly correct, but is not scientifically exact. Asamayama is 8,284 feet high (Rein). The last fatal eruption took place in 1783, and the last emission of ashes occurred in 1870, while the evidences of volcanic eruption are much more conspicuous than they are around Fujiyama, the height of which is 12,287 feet (ibid.), and which has been quiet—i. e., not violently active—since 1707. But when one sees the "hot" place on the side of Fuji, it becomes very apparent that the activity of Asama is very little greater than that of her peerless sister. The heat at one place on Fuji is so great as to be perceptible to the hand. Snow will not lie; and it is said that there is an escape of steam.

Borings of rock-salt at Ellsworth and Kingman, Kansas, were described by Mr. Robert Hay at the meeting of the American Association. The veins were discovered in April and August, 1888. One hundred and fifty-five barrels of salt were manufactured in Kansas in 1888, and it is estimated that the output of 1889 will not be less than three times as large.

Respecting "artists' colors," Dr. A. P. Laurie said, in the British Association, that one point that came out in the course of his inquiries about the colors used by the old masters was the fact that they largely employed vegetable pigments, many of which were not used by modern painters. His researches into the ordinary methods of manufacturing colors showed that great variations prevailed in different makes of the same color, and the matter was an important one to look after. One of the most valuable oils used by the old masters was that of the walnut.

The work of Columbus is to be commemorated in Italy according to a scheme adopted by a Royal Commission, which includes the publication of a "Raccolta Colombiana" in six volumes, devoted to (1) the writings of Columbus; (2) Columbus and his family; (3) the discovery of America; (4) navigation and cartography of the discovery; (5) monographs (Italian precursors and continuers of the work of Columbus); (6) bibliography. This work will apparently be the outcome of a large amount of diligent research.

The establishment of a biological laboratory for the observation and study of fresh-water *Algæ* was suggested by Mr. William R. Dudley, in a paper read at the meeting of the American Association.

Prof. J. W. Mallet has found, in experiments upon alum baking-powders, that most of the preparations of that class in the market are made with alum, the acid phosphate of calcium, bicarbonate of sodium, and starch. Among the resultants of the chemical changes by baking are aluminum hydroxide and phosphate. These substances, in doses not very greatly exceeding such quantities as may be derived from bread as commonly used, produce an inhibitory effect upon gastric digestion. This effect is probably due to precipitation in insoluble form of the organic substance constituting the peptic ferment and of some of the organic matter of food. Hence it is concluded that "not only alum itself, but the residues which its use in baking-powder leaves in bread, can not be viewed as harmless, but must be ranked as objectionable."

According to a calculation furnished us by Prof. William Harkness, of the Naval Observatory, "a body weighing one pound avoirdupois on a *spring balance* at the earth's equator would weigh only 0·16584 of a pound, or 2·6534 ounces, upon the same *spring balance*, at the moon's equator. In the statements on this subject appearing in books the centrifugal force is neglected. It amounts to 24 grains in an avoirdupois pound of 7,000 grains.

According to a paper by Prof. Wiley, in the Society for promoting Agriculture, the butter of cows fed on cotton-seed is marked by the presence of a small supply of volatile acid and a high melting-point. The power possessed by cotton-seed oil of acting on silver, passes through the animal, and appears in the butter made from its milk—a fact which shows that substances can be carried directly from the food to the butter. A new standard of analysis will have to be adapted to the butters of cows fed on cotton-seed oil, for the low amount of volatile acid contained in them would cause them to be condemned as spurious.

The relative values as foods of the grains named below are given by Prof. Wiley as, first, wheat; second, sorghum; third, maize; fourth, unhulled oats. Sorghum-seed furnishes a flour like buckwheat, that makes passable bread, and is coming into considerable use.

The workmen in the Venetian glass factories at Murano, according to Dr. Salviati, fall victims in time to failure of eye-sight and ultimate blindness, caused by the excessive heat and intense glare of the furnaces. As they live simply and receive high wages, they are usually able to save enough before the disability comes upon them to support them for the remainder of their lives.

Prof. Renzi, of Naples, has reported cures of tetanus by securing absolute rest for the patient—that is, rest for the senses as well as for the body. The patient's ears are closed with wax, his room is dark, and the floor is heavily carpeted. His nurse attends him with a shaded lantern; he is served food that requires no mastication; and sedatives are given to relieve pain. It is not pretended that this treatment shortens the period of the disease, but that it lessens the force of the paroxysms, which eventually cease.

Experiments by Dr. Pinel show that hypnotic patients will obey the directions conveyed to them mechanically by the phonograph as readily as they will obey living words. Hence, he argues, the theory of animal magnetism—that is, of a magnetic current passing from operator to subject—is baseless; and the real cause of the phenomena of hypnotism is a disordered mental state.

A. W. Buckland has endeavored to restore to the moon the credit that has been snatched from it of having influence over the weather and the welfare of men. Some of the superstitions relative to the moon may be traced to the old moon-worship. For others, Mr. Buckland assumes, ground may be found in fact. Meteorologists deny any influence of the moon upon weather; but the moon raises the tides of the ocean, and it also creates tides in the air, which have received no attention from science. We are ignorant of the forces that may reside in the air-tides and of the phenomena that may be dependent upon them.

Mr. Bosworth Smith, in a report on the Kolar gold-field, in southern India, records some finds of old mining implements, old timbering, fragments of bones, an old oil-lamp, and broken pieces of earthenware, including a crucible, the remains of ancient mining operations. He expresses astonishment at the fact that the old miners were able to reach depths of two hundred or three hundred feet through hard rock, with the simple appliances at their command.

Buffaloes are said to be becoming very abundant and increasing rapidly in northern Australia, where they were introduced about 1829. They are described as being massive and heavy, "with splendid horns," and affording fine sport for bold hunters.

In the discussion in the British Association of the report of the Committee on Science Teaching in the Elementary Schools (which exhibited a continued decline), Sir Benjamin Browne said that the school boards would be amazed at the high standard of the qualifications of the lads who came to his firm to be apprenticed engineers. Recently a boy thirteen years of age came to him, and he failed to puzzle him with problems from Euclid. His opinion was, that whatever could be done voluntarily was better than what could be done by the Government.

Dr. D. G. Brinton, of Philadelphia, announces as in press a collection of sacred songs of the ancient Mexicans, entitled "Rig Veda Americana," with a gloss in Nahuatl, paraphrase, notes, and vocabulary. The texts are derived from two Nahuatl manuscripts, one at Madrid and the other at Florence, both of which have been personally collated by the editor. This volume will form number eight of the "Library of Aboriginal American Literature."

An instrument called the telegraphone has been patented, which enables the sender to record his message on a cylinder attached to the receiving instrument, in the absence of any one to hear it, and even to repeat the message back to himself for correction.

Mr. De Cort Smith, at the American Association, exhibited specimens of the Shamanic masks and rattles of the Onondaga Indians, and exemplified their use. The masks are symbolical of supernatural evil beings, and their aid is invoked to drive away witches. The spirits are believed to cause or remove illness. They are propitiated with feasts and sacrifices of tobacco.

OBITUARY NOTES.

Prof. Victor Eggertz, late head of the School of Mines of Sweden, died in Stockholm in the last days of August. He was the inventor of what is called the coloration test for analyzing carbon in iron and steel.

Mr. E. F. H. Francis, Professor of Chemistry in Queen's College, Georgetown, Demerara, and analytical chemist to the Government, has recently died, aged thirty-nine years. He went to the service in British Guiana from a similar position in Trinidad in 1875.

Señor Don Sebastian Vidal, who died at Manila July 28, 1889, had been for several years Inspector-General of Forests and Director of the Botanic Garden at Manila, and was the author of several works on Philippine botany. He was practically a pioneer in the investigation of the Philippine flora, and has determined several peculiarities distinguishing it from the allied Malayan flora.

Mr. John Ball, F. R. S., a distinguished traveler, Alpine explorer, and botanist, of England, died in London, October 10, 1889, soon after returning from an excursion to the Dolomite Alps. He was born in Dublin in 1818; won high mathematical honors at Cambridge; was called to the bar, and appointed an assistant Poor Law Commissioner, served in Parliament and as Under Secretary for the Colonies, and then withdrew from public life and devoted himself to Alpine exploration and botany. He accompanied Sir Joseph Hooker to Morocco, and wrote an account of the botany and natural history of the highlands of that country. He also visited Peru and Patagonia and the Island of Teneriffe, for scientific exploration. He published an "Alpine Guide," which is spoken of as a work of standard merit.

The distinguished French chemist, Dr. Augustin Quesneville, died on the 4th of November, 1889, aged eighty years. He was a pupil of Vauquelin's, and succeeded him in his factory. Having attended Chevreul's lectures, he was admitted as a doctor of medicine in 1834, from which time he devoted himself to the study of science and industrial chemistry. In 1840 he founded a monthly journal, called at first the "Revue Scientifique," but after 1857 the "Moniteur Scientifique," devoted to chemistry and its industrial applications. This journal was continued till October last, when the veteran editor gave it up, on account of the pressure of old age.

"Ciel et Terre" records the death, on the 10th of October, in his sixty-sixth year, of M. François Henri Carlier, proprietor and director of the Meteorological Observatory of Saint Martin-de-Hinx in the Landes. This establishment is described as having been a model one, and better furnished than many state-supported observatories. The observations taken there under M. Carlier during the past twenty-five years form one of the most important contributions to the study of the climate of the extreme southeast of France.

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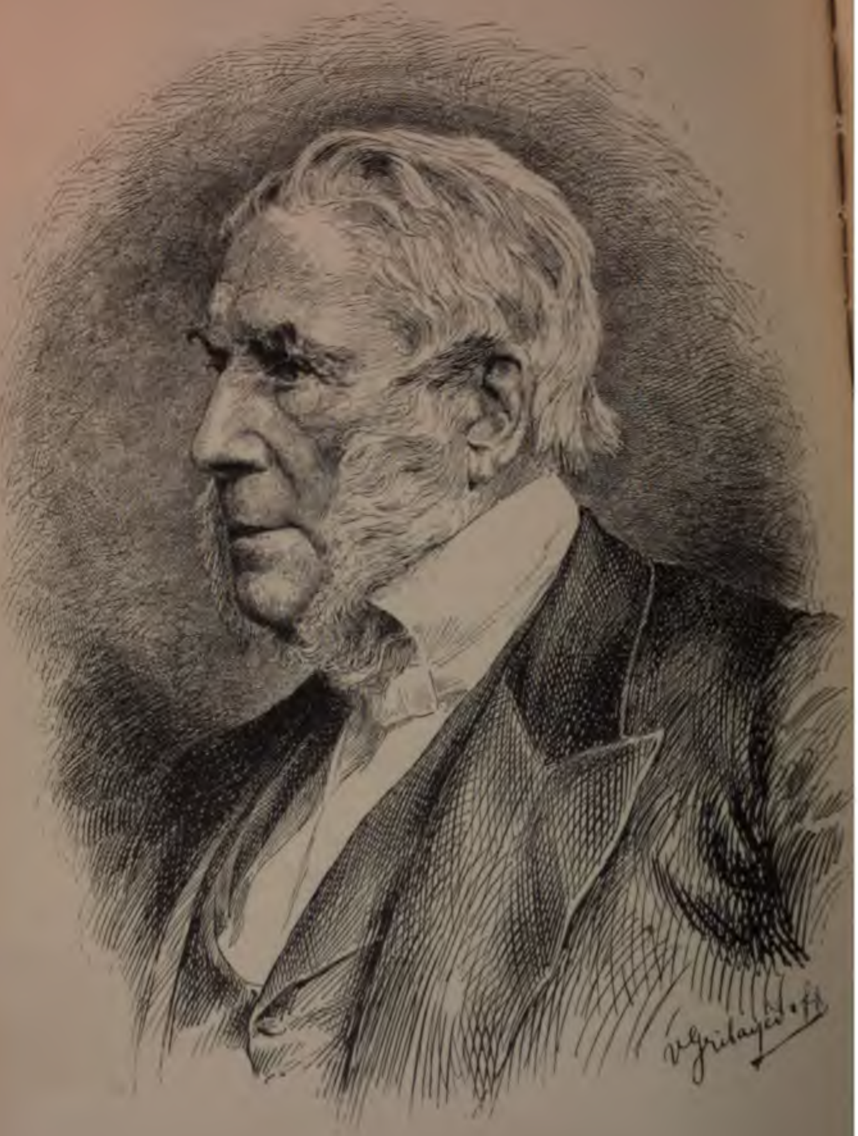

JAMES GLAISHER.

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NEW CHAPTERS IN THE WARFARE OF SCIENCE.

VII. COMPARATIVE MYTHOLOGY.

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PART I.

A FEW years since, Maxime Du Camp, an eminent member of the French Academy, traveling from the Red Sea to the Nile through the Desert of Kosseir, came to a barren slope covered with bowlders, rounded and glossy.

His Mohammedan camel-drivers accounted for them on this wise:

"Many years ago Hadji Abdul-Aziz, a sheik of the dervishes, was traveling on foot through this desert; it was summer; the sun was hot and the dust stifling; thirst parched his lips, fatigue weighed down his back, sweat dropped from his forehead, when looking up he saw—on this very spot—a garden beautifully green, full of fruit, and, in the midst of it, the gardener.

"'O fellow-man,' cried Hadji Abdul-Aziz, 'in the name of Allah, clement and merciful, give me a melon and I will give you my prayers.'

"The gardener answered, 'I care not for your prayers; give me money, and I will give you fruit.'

"'But,' said the dervish, 'I am a beggar; I have never had money; I am thirsty and weary, and one of your melons is all that I need.'

"'No,' said the gardener, 'go to the Nile and quench your thirst.'

"Thereupon the dervish, lifting his eyes toward heaven, made this prayer: 'O Allah, thou who in the midst of the desert didst make the fountain of Zem-Zem spring forth to satisfy the thirst of Ismail, father of the faithful; wilt thou suffer one of thy creatures to perish thus of thirst and fatigue?'

"And it came to pass that, hardly had the dervish spoken, when an abundant dew descended upon him, quenching his thirst and refreshing him even to the marrow of his bones.

"Now at the sight of this miracle the gardener knew that the dervish was a holy man, beloved of Allah, and straightway offered him a melon.

"'Not so,' answered Hadji Abdul-Aziz, 'keep what thou hast, thou wicked man. May thy melons become as hard as thy heart, and thy field as barren as thy soul!'

"And straightway it came to pass that the melons were changed into these blocks of stone, and the grass into this sand, and never since has anything grown thereon."

In this story, and in myriads like it, we have a survival of that early conception of the universe in which so many of the leading moral and religious truths of the great sacred books of the world are imbedded.

All ancient sacred lore abounds in such mythical explanations of remarkable appearances in nature, and these are most frequently prompted by mountains, rocks, and bowlders seemingly misplaced.

In India we have such typical examples among the Brahmans as the mountain-peak which Durgu threw at Parvati; and among the Buddhists the stone which Devadatti hurled at Buddha.

In Greece the Athenian, rejoicing in his belief that Athena guarded her chosen people, found it hard to understand why the great rock Lycabettus should be just too far from the Acropolis to be of use as an outwork; but a myth was developed which explained all. According to this, Athena had intended to make Lycabettus a defense for the Athenians, and she was bringing it through the air from Pallene for that very purpose; but, unfortunately, a raven met her and informed her of the wonderful birth of Erichthonius, which so surprised the goddess that she dropped the rock where it now stands.

So, too, a peculiar rock at Ægina was accounted for by a long and circumstantial legend to the effect that Peleus threw it at Phocas.

A similar mode of explaining such objects is seen in the mythologies of northern Europe. In Scandinavia we constantly find rocks which tradition accounts for by declaring that they were hurled by the old gods at each other, or at the early Christian churches.

In Teutonic lands, as a rule, wherever a strange rock or stone is found, there will be found a myth or a legend, heathen or Christian, to account for it.

So, too, in Celtic countries; typical of this mode of thought in Brittany and in Ireland is the popular belief that such features in the landscape were dropped by the devil or by fairies.

Even at a much later period such myths have grown and bloomed; Marco Polo gives a long and circumstantial legend of a mountain in Asia Minor which, not long before his visit, was removed by a Christian who had "faith as a grain of mustard-seed," and, remembering the Saviour's promise, transferred the mountain to its present place by prayer, "at which marvel many Saracens became Christians."*

Similar mythical explanations are also found, in all the older religions of the world, for curiously marked meteoric stones, fossils, and the like.

Typical examples are found in the imprint of Buddha's feet on stones in Siam and Ceylon; in the imprint of the body of Moses, which down to the middle of the last century was shown near Mount Sinai; in the imprint of Poseidon's trident on the Acropolis at Athens; in the imprint of the hands or feet of Christ on stones in France, Italy, and Palestine; in the imprint of the Virgin's tears on stones at Jerusalem; in the imprint of the feet of Abraham at Jerusalem and of Mohammed on a stone in the Mosque of Khait Bey at Cairo; in the imprint of the fingers of giants on stones in the Scandinavian Peninsula, in north Germany, and in western France; in the imprint of the devil's thighs on a rock in Brittany, and of his claws on stones which he threw at churches in Cologne and Saint Pol-de-Léon; in the imprint of the shoulder of the devil's grandmother on the "elbow-stone" at the Mohrinersee; in the imprint of St. Otho's feet on a stone formerly preserved in the castle church at Stettin; in the imprint of the little finger of Christ and the head of Satan at Ehrenberg; and in the imprint of the feet of St. Agatha at Catania, in Sicily. To account for these appearances and myriads of others, long and interesting legends were developed, and out of this mass we may take one or two as typical.

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* For Maxime Du Camp, see "Le Nil, Egypte et Nubie," Paris, 1877, chapter v. For India, see Düncker, "Geschichte des Alterthums," iii, 366; also Coleman, "Mythology of the Hindus," p. 90. For Greece, as to the Lycabettus myth, see Leake, "Topography of Athens," vol. i, sec. 3; also Burnouf, "La Légende Athénienne," p. 152. For the rock at Ægina, see Charton, vol. i, p. 310. For Scandinavia, see Thorpe, "Northern Antiquities," *passim*. For Teutonic countries, see Grimm, "Deutsche Mythologie"; Panzer, "Beitrag zur deutschen Mythologie," vol. ii; and especially J. B. Friedrich, "Symbolik und Mythologie der Natur," pp. 116 *et seq.* For Celtic examples I am indebted to that learned and genial scholar, Prof. J. P. Mahaffy, of Trinity College, Dublin. See also story of the devil dropping a rock when forced by the archangel Michael to aid him in building Mont Saint-Michel on the west coast of France, in Sébillot's "Traditions de la Haute-Bretagne," vol. i, p. 22; also multitudes of other examples in the same work. For Marco Polo, see in Grynæus, p. 337; also Charton, "Voyageurs anciens et modernes," pp. 274 *et seq.*, where the long and circumstantial legend is given.

One of the most beautiful was evolved at Rome. On the border of the mediæval city stands the church of "Domine quo vadis"; it was erected in honor of a stone, which is still preserved, bearing a mark resembling a human footprint—perhaps the bed of a fossil.

Out of this a pious legend grew as naturally as a wild rose in a prairie. According to this story, in one of the first great persecutions the heart of St. Peter failed him, and he attempted to flee from the city; arriving outside the walls he was suddenly confronted by the Master, whereupon Peter in amazement asked, "Lord, where goest thou?" (*Domine quo vadis?*); to which the Master answered, "To Rome, to be crucified again." The apostle, thus rebuked, returned to martyrdom; the Master vanished, but left, as a perpetual memorial, his footprint in the solid rock.

Still another legend accounts for a curious mark in a stone at Jerusalem. According to this, St. Thomas, after the ascension of the Lord, was again troubled with doubts, whereupon the Virgin Mother threw down her girdle, which left its imprint upon the rock, and thus converted the doubter fully and finally.

And still another example is seen at the very opposite extreme of Europe, in the legend of the priestess of Hertha in the island of Rugen. She had been unfaithful to her vows, and the gods furnished a proof of her guilt by causing her and her child to sink into the rock on which she stood.*

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* For myths and legends crystallizing about bowlders and other stones curiously shaped or marked, see, on the general subject, in addition to works already cited, Des Brosses, "Les Dieux Fétiches," 1760, *passim*, but especially pp. 166, 167; and for a condensed statement as to worship paid them, see Gerard de Rialle, "Mythologie comparée," vol. vi, chapter ii. For imprints of Buddha's feet, see Tylor, "Researches into the Early History of Mankind," London, 1878, pp. 115 *et seq.*; also Coleman, p. 203, and Charton, "Voyageurs anciens et modernes," pp. 365, 366, where engravings of one of the imprints, and of the temple above another, are seen. There are five which are considered authentic by the Siamese, and a multitude of others more or less strongly insisted upon. For the imprint of Moses' body, see travelers from Sir John Maundeville down. For the mark of Neptune's trident, see last edition of Murray's "Handbook of Greece," vol. i, p. 322; and Burnouf, "La Légende Athénienne," p. 153. For imprint of the feet of Christ, and the Virgin's girdle and tears, see many of the older travelers in Palestine, as Arculf, Bouchard, Roger, and especially Bertrandon de la Brocquière in Wright's "Collection," pp. 339, 340; also Maundrell's "Travels" and Maundeville. For the curious legend regarding the imprint of Abraham's foot, see Weil, "Biblische Legenden der Muselmänner," pp. 91 *et seq.* For many additional examples in Palestine, particularly the imprints of the bodies of three apostles on stones in the Garden of Gethsemane and of St. Jerome's body in the desert, see Beauvau, "Rélation du Voyage du Levant," Nancy, 1615, *passim*. For the various imprints made by Satan and giants in Scandinavia and Germany, see Thorpe, ii, 85; Friedrichs, pp. 126 and *passim*. For a very rich collection of such explanatory legends regarding stones and marks in Germany, see Karl Bartsch, "Sagen, Märchen und Gebräuche aus Mecklenburg," Wien, 1880, vol. ii, pp. 420 *et seq.* For a woodcut representing the imprint of St. Agatha's feet at Catania, see Charton, "Voyageurs anciens et modernes," vol. ii, p. 75. For a woodcut representing the imprint of Christ's feet on the stone from which he ascended to heaven, see woodcut in Maundeville, edition of 1484, in the White Library,

Another and very fruitful source of explanatory myths is found in ancient centers of volcanic action, and especially in old craters of volcanoes and fissures filled with water.

In China we have, among other examples, Lake Man, which was once the site of the flourishing city Chiang Shui, overwhelmed and sunk on account of the heedlessness of its inhabitants regarding a divine warning.

In Phrygia the lake and morass near Tyana were ascribed to the wrath of Zeus and Hermes, who, having visited the cities which formerly stood there, and having been refused shelter by all the inhabitants save Philemon and Baucis, sank the wicked cities beneath the lake and morass, but rewarded their benefactors.

Stories of similar import grew up to explain the crater near Sipylos in Asia Minor and that of Avernus in Italy; the latter came to be considered the mouth of the infernal regions, as every school-boy knows when he has read his Virgil.

In the later Christian mythologies we have such typical legends as those which grew up about the old crater in Ceylon; the salt water in it was accounted for by supposing it the tears of Adam and Eve, who retreated to this point after their expulsion from paradise and bewailed their sin during a hundred years.

So, too, in Germany we have multitudes of lakes supposed to owe their origin to the sinking of valleys as a punishment for human sin. Of these are the "Devil's Lake," near Güstrow, which rose and covered a church and its priests on account of their corruption; the lake at Probst-Jesar, which rose and covered an oak-grove and a number of peasants resting in it on account of their want of charity to beggars; and the Lucin Lake, which rose and covered a number of soldiers on account of their cruelty to a poor peasant.

Such legends are found throughout America and in Japan, and will doubtless be found throughout Asia and Africa, and especially among the volcanic lakes of South America, the pitch lakes of the Caribbean Islands, and even about the Salt Lake of Utah; for explanatory myths and legends under such circumstances are inevitable.[*]

Cornell University. For the legend of *Domine quo vadis*, see many books of travel and nearly all guide-books for Rome, from the mediæval "Mirabilia Romæ" to the latest edition of Murray. The footprints of Mohammed at Cairo were shown to the present writer in 1889. On the general subject, with many striking examples, see Falsan, "La Période glaciaire," Paris, 1889, pp. 17 and 294, 295.

[*] As to myths explaining volcanic craters and lakes, and embodying ideas of the wrath of Heaven against former inhabitants of the neighboring country, see Forbiger, "Alte Geographie," Hamburg, 1877, i, 563. For exaggerations concerning the Dead Sea, see ibid., i, 575. For the sinking of Chiang Shui and other examples, see Denny's "Folklore of China," p. 126 *et seq.* For the sinking of the Phrygian region, the destruction of its inhabi-

To the same manner of explaining striking appearances in physical geography, and especially strange rocks and bowlders, we mainly owe the innumerable stories of the transformation of living beings, and especially of men and women, into these natural features.

In the mythology of China we constantly come upon legends of such transformations—from that of the first counselor of the Han dynasty to those of shepherds and sheep. In the Brahmanical mythology of India, Salagrama, the fossil ammonite, is recognized as containing the body of Vishnu's wife, and the Binlang stone has much the same relation to Siva; so, too, the nymph Ramba was changed, for offending Ketu, into a mass of sand; by the breath of Siva elephants were turned into stone, and in a very touching myth Luxman is changed into stone but afterward released. In the Buddhist mythology a Nat demon is represented as changing himself into a grain of sand.

Among the Greeks such transformation-myths come constantly before us—both the changing of stones to men and the changing of men to stones. Deucalion and Pyrrha, escaping from the flood, repeopled the earth by casting behind them stones which became men and women; Heraulos was changed into stone for offending Mercury; Pyrrhus for offending Rhea; Phineus, and Polydektes with his guests, for offending Perseus; under the petrifying glance of Medusa's head such transformations became a thing of course.

To myth-making in obedience to the desire of explaining striking natural appearances, coupled with the idea that sin must be followed by retribution, we also owe the well-known Niobe myth. Having incurred the divine wrath, she saw those dearest to her destroyed by missiles from heaven, and was finally transformed into a rock on Mount Sipylos which bore some vague resemblance to the human form, and her tears became the rivulets which trickled from the neighboring strata.

Thus, in obedience to a moral and intellectual impulse, a striking geographical appearance was explained, and for ages pious Greeks looked with bated breath upon the rock at Sipylos which was once Niobe, just as for ages pious Jews, Christians, and Mohammedans looked with awe upon the salt pillar at the Dead Sea which was once Lot's wife.

tants, and the saving of Philemon and Baucis, see Ovid's "Metamorphoses," Book VIII; also Bötticher, "Baumcultus der Alten," etc. For the lake in Ceylon arising from the tears of Adam and Eve, see variants of the original legend in Maundeville and in Jürgen Andersen, "Reisebeschreibung," 1669, ii, 132. For the volcanic nature of the Dead Sea, see Daubeny cited in Smith's "Dictionary," 1873, *sub voc.* "Palestine." For lakes in Germany owing their origin to human sin and various supernatural causes, see Karl Bartsch, "Sagen, Märchen und Gebräuche aus Mecklenburg," vol. i, pp. 897 *et seq.* For lakes in America, see any good collection of Indian legends. For lakes in Japan sunk supernaturally, see Braun's "Japanesische Märchen und Sagen," Leipsic, 1885, pp. 850, 361.

Pausanias, one of the most honest of ancient travelers, gives us a striking exhibition of this feeling. Having visited this monument of divine vengeance at Mount Sipylos, he tells us very naïvely that, though he could discern no human features when standing near it, he thought that he could see them when standing at a distance. There could hardly be a better example of that most common and deceptive of all things—belief created by the desire to believe.

In the pagan mythology of Scandinavia we have such typical examples as Börs slaying the giant Ymir and transforming his bones into bowlders; also "the giant who had no heart" transforming six brothers and their wives into stone; and, in the old Christian mythology, St. Olaf changing into stone the wicked giants who opposed his preaching.

So, too, in Celtic countries we have in Ireland such legends as those of the dancers turned into stone; and in Brittany, the stones at Plessé, which were once hunters and dogs violating the sanctity of Sunday; and the stones of Carnac, which were once soldiers who sought to kill St. Cornely.

Teutonic mythology inherited from its earlier Eastern days a similar mass of old legends, and developed a still greater mass of new ones. Thus, near the Königstein, which all visitors to the Saxon Switzerland know so well, is a bowlder which for ages was believed to have once been a maiden transformed into stone for refusing to go to church; and near Rosenberg in Mecklenburg is another curiously shaped stone of which a similar story is told. Near Spornitz, in the same region, are seven bowlders whose forms and position are accounted for by a long and circumstantial legend that they were once seven impious herdsmen; near Brahlsdorf is a stone which, according to a similar explanatory myth, was once a blasphemous shepherd; near Schwerin are three bowlders which were once wasteful servants; and at Neustadt, down to a recent period, was shown a collection of stones which were once a bride and bridegroom with their horses and wagon—all punished for an act of cruelty; and these stories are but typical of thousands.

At the other extremity of Europe we may take, out of the multitude of explanatory myths, that which grew about the well-known group of bowlders near Belgrade. In the midst of them stands one larger than the rest: according to the legend which was developed to account for all these, there once lived there a swineherd, who was disrespectful to the consecrated host; whereupon he was changed into the larger stone, and his swine into the smaller ones. So also at Saloniki we have the pillars of the ruined temple, which are widely believed, especially among the Jews of that region, to have once been human beings, and are therefore known as the "enchanted columns."

Among the Arabs we have an addition to our sacred account of Adam—the legend of the black stone of the Caaba at Mecca, into which the angel was changed who was charged by the Almighty to keep Adam away from the forbidden fruit, and who neglected his duty.

Similar old transformation legends are abundant among the Indians of America, the negroes of Africa, and the natives of Australia and the Pacific islands.

Nor has this making of myths to account for remarkable appearances yet ceased, even in civilized countries.

About the beginning of this century the Grand Duke of Weimar, smitten with the classical mania of his time, placed in the public park near his palace a little altar, and upon this was carved, after the manner so frequent in classical antiquity, a serpent taking a cake from it.

And shortly there appeared, in the town and the country around about, a legend to explain this altar and its decoration. It was commonly said that a huge serpent had laid waste that region in the olden time, until a wise and benevolent baker had rid the world of the monster by means of a poisoned biscuit.

So, too, but a few years since, in the heart of the State of New York, a swindler of genius having made and buried a "petrified giant," one theologian explained it by declaring it a Phœnician idol, and published the Phœnician inscription which he thought he had found upon it; others saw in it proofs that "there were giants in those days," and within a week after its discovery myths were afloat that the neighboring remnant of the Onondaga Indians had traditions of giants who frequently roamed through that region.*

* For transformation myths and legends, identifying rocks and stones with gods and heroes, see Welcker, "Götterlehre," pp. 218 *et seq.* For recent and more accessible statements for the general reader, see Robertson Smith's admirable "Lectures on the Religion of the Semites," Edinburgh, 1889, pp. 86 *et seq.* For some thoughtful remarks on the ancient adoration of stones rather than statues, with reference to the anointing of the stones at Bethel by Jacob, see Dodwell, "Tour through Greece," vol. ii, p. 172; also Robertson Smith as above, Lecture V. For Chinese transformation legends, see Denny's "Folklore of China," pp. 96 and 128. For Hindu and other ancient legends of transformations, see Dawson, "Dictionary of Hindu Mythology," also Coleman as above, also Cox, "Mythology of the Aryan Nations," pp. 81–97, etc. For such transformations in Greece, see the "Iliad," and Ovid as above; also Stark, "Niobe und die Niobiden," p. 444 and elsewhere; also Preller, "Griechische Mythologie," ii, 383; also Baumeister, "Denkmäler des classischen Alterthums," Art. "Niobe"; also Bötticher as above; also Curtius, "Griechische Geschichte," vol. i, pp. 71, 72. For Pausanius's *naïve* confession regarding the Sipylos rock, see Book I, 215. See also Texier, "Asie Mineure," pp. 265 *et seq.*; also Chandler, "Travels in Greece," vol. ii, p. 60, who seems to hold to the later origin of the statue. At the end of Baumeister there is an engraving copied from Stuart which seems to show that, as to the Niobe legend, at a later period Art was allowed to help Nature. For the general subject, see Schäffle, "Program des K. Gymnasiums," in Ellwangen, "Mythologische Parallelen," 1865. For Scandinavian and Teutonic transformation legends, see Grimm, "Deutsche Mythologie," vierte Ausg., i

To the same stage of thought belongs the conception of human beings changed into trees.

But, in the historic evolution of religion and morality, while changes into stone or rock were considered as punishment, or evidence of divine wrath, those into trees and shrubs were frequently looked upon as rewards, or evidences of divine favor.

A very beautiful and touching form of this conception is seen in such myths as the change of Philemon into the oak, and of Baucis into the linden; of Myrrha into the myrtle; of Melos into the apple-tree; of Attys into the pine; of Adonis into the rose-tree; and in the springing of the vine and grape from the blood of the Titans, the violet from the blood of Attys, and the hyacinth from the blood of Hyacinthus.

Thus it was, during the long ages when mankind saw everywhere miracle and nowhere law, that, in the evolution of religion and morality, striking features in physical geography became connected with the idea of divine retribution.*

But, in the natural course of intellectual growth, thinking men began to doubt the historical accuracy of these myths and legends —or, at least, to doubt all save those of the theology in which they happened to be born; and the next step was taken when they began to make comparisons between the myths and legends of different neighborhoods and countries; so came into being the science

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457; also Thorpe, "Northern Antiquities"; also Friedrich, *passim*, especially p. 116 *et seq.;* also, for a mass of very curious ones, Karl Bartsch, "Sagen, Märchen und Gebräuche aus Mecklenburg," vol. i, p 420, *et seq.;* also Karl Simrock's edition of the "Edda," ninth edition, p. 319; also John Fiske, "Myths and Myth-Makers," pp. 8 and 9. On the universality of such legends and myths, see Ritter's "Erdkunde," xiv, 1098–1122. For Irish examples, see Manz, "Real Encyclopädie," art. "Stein"; and for multitudes of examples in Brittany, see Sébillot, "Traditions de la Haute-Bretagne." For the enchanted columns at Saloniki, see latest edition of Murray's "Handbook of Turkey," vol. ii, p. 711. For the legend of the angel changed into stone for neglecting to guard Adam, see Weil, university librarian at Heidelberg, "Biblische Legende der Muselmänner," Frankfort-am-Main, 1845, pp. 37 and 84. For similar transformation legends in Australia and among the American Indians, see Andrew Lang, "Mythology," French translation, pp. 83 and 102; also his "Myth Ritual and Religion," vol. i, pp. 150 *et seq.*, citing numerous examples from J. G. Müller, "Urreligionen," Dorman's "Primitive Superstitions," and "Report of the Bureau of Ethnology" for 1880–'81; and for an African example, see account of the rock at Balon which was once a woman, in Bérenger-Feraud, "Contes populaires de la Sénégambie," chap. viii. For the Weimar legend, see Lewes, "Life of Goethe," Book IV. For the myths which arose about the swindling "Cardiff Giant" in the State of New York, see especially an article by G. A. Stockwell, M. D., in "The Popular Science Monthly" for June, 1878; and for the "Phœnician inscription," given at length with a translation, see the Rev. Alexander McWhorter, in "The Galaxy" for July, 1872. The present writer has in his possession a mass of curious documents regarding this fraud and the myths to which it gave rise, and hopes ere long to prepare a supplement to Dr. Stockwell's valuable paper.

* For the view taken in Greece and Rome of transformations into trees and shrubs, see Bötticher, "Baumcultus der Alten," xix, pp. 2 and 3; also Ovid, "Metamorphoses," *passim;* also foregoing notes.

of Comparative Mythology—a science sure to be of vast value, because, despite many stumblings and vagaries, it shows ever more and more how our religion and morality have been gradually evolved, and gives a firm basis to faith that higher planes may yet be reached.

Such a science makes the sacred books of the world more and more precious, in that it shows how they have been the necessary envelopes of our highest spiritual sustenance; how even myths and legends apparently the most puerile have been the natural husks and rinds and shells of our best ideas; and how the atmosphere is created in which these husks and rinds and shells in due time wither, shrivel, and fall away, so that the fruit itself may be gathered to sustain a nobler religion and a purer morality.

The coming in of Christianity contributed elements of inestimable value in this evolution, and, at the center of all, the thoughts, words, and life of the Master. But when, in the darkness that followed the downfall of the Roman Empire, there was developed a theology and a vast ecclesiastical power to enforce it, the most interesting chapters in this evolution of religion and morality were unfortunately removed from the domain of science.

So it came that for over eighteen hundred years it has been thought natural and right to study and compare the myths and legends arising east and west and south and north of Palestine with each other, but never with those of Palestine itself; so it came that one of the regions most fruitful in materials for reverent thought and healthful comparison was held exempt from the unbiased search for truth; so it came that, in the name of truth, truth was crippled for ages. While observation, and thought upon observation, and the organized knowledge or science which results from these, progressed as regarded the myths and legends of other countries, and an atmosphere was thus produced giving purer conceptions of the world and its government; myths of that little geographical region at the eastern end of the Mediterranean retained possession of the civilized world in their original crude form, and have at times done much to thwart the noblest efforts of religion, morality, and civilization.

The history of myths—of their growth under the earlier phases of human thought and of their decline under modern thinking—is one of the most interesting and suggestive of human studies; but, since to treat it as a whole would require volumes, I shall select only one small group, and out of this mainly a single myth—one about which there can no longer be any dispute—the group of myths and legends which grew upon the shore of the Dead Sea, and especially that one which grew up to account for the successive salt columns at its southwestern extremity.

The Dead Sea is about thirty-nine geographical miles in length and nine miles in width; it lies in a very deep fissure extending north and south, and its surface is about thirteen hundred feet below that of the Mediterranean. It has, therefore, no outlet, and is the receptacle for the waters of the whole system to which it belongs, including those collected by the Sea of Galilee and brought down thence by the river Jordan.

It certainly—or, at least, the larger part of it—ranks geologically among the oldest lakes on earth. In a broad sense the region is volcanic: on its shore are evidences of volcanic action which must, from the earliest period, have aroused wonder and fear, and stimulated the myth-making tendency to account for them. On the eastern side are impressive mountain-masses which have been thrown up from old volcanic vents; mineral and hot springs abound, some of them spreading sulphurous odors; earthquakes have been frequent, and from time to time these cast up masses of bitumen; concretions of sulphur and large formations of salt constantly appear.

The water which comes from the springs or oozes through the salt layers upon its shores constantly brings in various salts in solution, and, being rapidly evaporated under the hot sun and dry wind, there has been left, in the bed of the lake, a strong brine heavily charged with the usual chlorides and bromides—a sort of bitter "mother liquor." This fluid has become so dense as to have a remarkable power of supporting the human body; is of an acrid and nauseating bitterness; and by ordinary eyes no evidence of life is seen in it.

Thus it was that in the lake itself, and in its surrounding shores, there was enough to make the generation of explanatory myths on a large scale inevitable.

The main northern part of the lake is very deep, the plummet having shown an abyss of thirteen hundred feet, but the southern end is shallow and in places marshy.

The system of which it forms a part shows a likeness to that in South America, of which the mountain lake Titicaca is the main feature; as a receptacle for surplus waters, only rendering them by evaporation, it resembles the Caspian and many other seas; as a sort of evaporating dish for the leachings of salt rock, and consequently holding a body of water unfit to support the higher forms of animal life, it resembles, among others, the Median lake of Urumiah; as a deposit of bitumen, it resembles the pitch lakes of Trinidad.

Striking, then, as was the Dead Sea in its appearance to prescientific man, there is nothing in it of extraordinary difficulty to the modern geologist or geographer.*

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* For modern views of the Dead Sea, see the Rev. Edward Robinson, D. D., "Biblical Researches," various editions; Lynch's "Exploring Expedition"; De Saulcy, "Voyage

At a very early period, myths and legends, many and long, grew up to explain features then so incomprehensible.

As the myth and legend grew up among the Greeks of a refusal of hospitality to Zeus and Hermes by the village in Phrygia, and the consequent sinking of that beautiful region with its inhabitants beneath a lake and morass, so there came a belief in a similiar offense by the people of the beautiful valley of Siddim, and the consequent sinking of that valley with its inhabitants beneath the waters of the Dead Sea. Very similar to the accounts of the saving of Philemon and Baucis are those of the saving of Lot and his family.

But the myth-making and miracle-mongering by no means ceased in ancient times; they continued to grow through the me-

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autour de la Mer Morte"; Stanley's "Palestine and Syria"; Schaff's "Through Bible Lands"; and other travelers hereafter quoted. For good "*photogravures*," showing the character of the whole region, see the portfolio forming part of De Luynes's monumental "Voyage d'Exploration." For geographical summaries, see Reclus, "La Terre," Paris, 1870, pp. 832–843; Ritter, "Erdkunde," volumes devoted to Palestine and especially as supplemented in Gage's translation with additions; Reclus, "Nouvelle Géographie Universelle," ix, 736, where a small map is given presenting difference in depth between the two ends of the lake, of which so much was made theologically before Lartet. For still better maps, see De Saulcy, and especially De Luynes, "Voyage d'Exploration" (portfolio). For very interesting panoramic views, see last edition of Canon Tristram's "Land of Israel," p. 635. For the geology, see Lartet, in his reports to the French Geographical Society, and especially in vol. iii of De Luynes's work, where there is an admirable geological map with sections, etc.; also Ritter; also Sir J. W. Dawson's "Egypt and Syria," published by the Religious Tract Society; also Rev. Cunningham Geikie, D. D., "Geology of Palestine"; and for pictures showing salt formation, Tristram, as above. For the meteorology, see Vignes, "Report to De Luynes," pp. 65 *et seq.* For chemistry of the Dead Sea, see as above, and Terreil's report, given in Gage's Ritter, vol. iii, Appendix 2, and tables in De Luynes's third volume. For zoölogy of the Dead Sea, as to entire absence of life in it, see all earlier travelers; as to presence of lower forms of life, see Ehrenberg's microscopic examinations in Gage's Ritter. See also reports in third volume of De Luynes. For botany of the Dead Sea, and especially regarding "apples of Sodom," see Dr. Lortet's "Palestine," p. 412; also Reclus, "Nouvelle Géographie," ix, 737. Also for photographic representations of them, see portfolio forming part of De Luynes's work, plate 27. On Strabo's very perfect description, etc., see lib. xvi, II, 44; also Fallmerayer, "Werke," pp. 177, 178. For names and positions of a large number of salt lakes in various parts of the world more or less resembling the Dead Sea, see De Luynes, iii, 242 *et seq.* For Trinidad "pitch-lakes," found by Sir Walter Raleigh in 1595, see Langegg, "El Dorado," Part I, p. 103, and Part II, p. 101; also Reclus, Ritter, *et al.* For the general subject, see Schenkel, "Bible Lexicon," *sub voc.* "Todtes Meer," an excellent summary. The description of the Dead Sea in Lenormant's great history is utterly unworthy of him, and must have been thrown together from old notes after his death. It is amazing to see in such a work the old superstition that birds attempting to fly over the sea are suffocated. See Lenormant, "Histoire ancienne de l'Orient," edition of 1888, vol. vi, p. 112. For the absorption and adoption of foreign myths and legends by the Jews, see Baring-Gould, "Myths," etc., p. 390. For the views of Greeks and Romans, see especially Tacitus, "History," Book V, Pliny, and Strabo, in whose remarks are the germs of many of the mediæval myths. For very curious examples of these, see Baierus, "De Excidio Sodomæ," Halle, 1700, *passim.*

diæval and modern period until they have quietly withered away in the light of modern scientific investigation, leaving to us the religious and moral truths they inclose.

It would be interesting to trace this whole group of myths: their origin in times prehistoric; their development in Greece and Rome; their culmination during the ages of faith; and their disappearance in the age of science. It would be especially instructive to note the conscientious efforts to prolong their life by making futile compromises between science and theology regarding them; but I shall mention this main group only incidentally, confining myself almost entirely to the one above named—the most remarkable of all—the myth which grew about the salt pillars of Usdum.

I select this mainly because it involves only elementary principles, requires no abstruse reasoning, and because all controversy regarding it is ended. There is certainly now no theologian with a reputation to lose who will venture to revive the idea regarding it which was sanctioned for hundreds, nay thousands, of years by theology, was based on Scripture, and was held by the universal Church until our own century.

The main feature of the salt region of Usdum is a low range of hills near the southwest corner of the Dead Sea, extending in a southeasterly direction for about five miles, and made up mainly of salt rock. This rock is soft and friable, and, under the influence of the heavy winter rains, it has been, without doubt, from a period long before human history, as it is now, cut ever into new shapes, and especially into pillars or columns, which sometimes bear a resemblance to the human form.

A clergyman who visited this spot about ten years since speaks of the appearance of this salt range as follows:

"Fretted by fitful showers and storms, its ridge is exceedingly uneven, its sides carved out and constantly changing; . . . and each traveler might have a new pillar of salt to wonder over at intervals of a few years." *

Few things could be more certain than that, in the indolent

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* As to the substance of the "pillars" or "statues" or "needles" of salt at Usdum, many travelers speak of it as "marl and salt." Irby and Mangles, in their "Travels in Egypt, Nubia, Syria, and the Holy Land," chapter vii, call it "salt and hardened sand." The citation as to frequent carving out of new "pillars" is from the "Travels in Palestine" of the Rev. H. F. Osborn, D. D. See also Palmer, "Desert of the Exodus," ii, pp. 478, 479. For engravings of the salt pillar at different times compare that given by Lynch in 1848, when it appeared as a column forty feet high, with that given by Palmer as the frontispiece to his "Desert of the Exodus," Cambridge, England, 1871, when it was small and "does really bear a curious resemblance to an Arab woman with a child upon her shoulders"; and this again with the picture of the salt formation at Usdum given by Canon Tristram, at whose visit there was neither "pillar" nor "statue." See "The Land of Israel," by H. B. Tristram, D. D., F. R. S., London, 1882, p. 324.

dream-life of the East, myths and legends would grow up to account for this as for other strange appearances in all that region. The question which a religious Oriental put to himself in ancient times at Usdum was substantially that which his descendant to-day puts to himself at Kosseir: "Why is this region thus blasted?" —"whence these pillars of salt?" or "whence these blocks of granite?"—"what aroused the vengeance of Jehovah or of Allah to work these miracles of desolation?"

And, just as Maxime Du Camp recorded the answer of the modern Shemite at Kosseir, so the compilers of the Jewish sacred books recorded the answer of the ancient Shemite at the Dead Sea; just as Allah at Kosseir blasted the land and transformed the melons into bowlders which are seen to this day, so Jehovah at Usdum blasted the land and transformed Lot's wife into a pillar of salt which is seen to this day.

No more difficulty was encountered in the formation of the Lot legend, to account for that rock resembling the human form, than in the formation of the Niobe legend, which accounted for a supposed human resemblance in the rock at Sipylos; it grew up just as we have seen thousands of similar myths and legends grow up about striking natural appearances in every home of the human race. Being thus consonant with the universal view regarding the relation of physical geography to the divine government, it became a treasure of the Jewish nation and of the Christian Church—a treasure not only to be guarded against all hostile intrusion, but to be increased, as we shall see, by the myth-making powers of Jews, Christians, and Mohammedans for thousands of years.

The spot where the myth originated was carefully kept in mind; indeed, it could not escape, for in that place alone was constantly seen the phenomena which caused the myth. We have a steady chain of testimony through the ages all pointing to the salt pillar as the irrefragable evidence of divine judgment. That great theological test of truth—the dictum of St. Vincent of Lerins—would certainly prove that the pillar was Lot's wife; for it was believed so to be by Jews, Christians, and Mohammedans from the earliest period down to a time almost within present memory—"always, everywhere, and by all." It would stand perfectly the ancient test insisted upon by Cardinal Newman, "*Securus judicat orbis terrarum.*"

For, ever since the earliest days of Christianity, the identity of the salt pillar with Lot's wife has been universally held and supported by passages in Genesis, in St. Luke's Gospel, and in the Second Epistle of St. Peter—coupled with a passage in the book of the Wisdom of Solomon, which to this day, by a majority in the Christian Church, is believed to be inspired, and from which are specially cited the words, "A standing pillar of salt is a monument of an unbelieving soul." *

Never was chain of belief more continuous. In the first century of the Christian era Josephus refers to the miracle, and declares regarding the statue, "I have seen it, and it remains at this day"; and Clement, Bishop of Rome, one of the most revered fathers of the Church, noted for the moderation of his statements, expresses a similar certainty, declaring that he knew the miraculous statue to be still standing.

In the second century that great father of the Church, bishop and martyr, Irenæus, not only vouched for it, but gave his approval to the belief that the soul of Lot's wife still lingered in the statue, giving it a sort of organic life; thus virtually began in the Church that amazing development of the legend which we shall see taking various forms through the middle ages—the story that the salt statue exercised certain physical functions which in these more delicate days can not be alluded to save under cover of a learned language.

This addition to the legend, which in these signs of life, as in other things, is developed almost exactly on the same lines with the legend of the Niobe statue in the rock of Mount Sipylos and the legends of human beings transformed into bowlders in various mythologies, was for centuries regarded as an additional confirmation of revealed truth.

In the third century the myth burst into still richer bloom in a poem long ascribed to Tertullian. In this poem more miraculous characteristics of the statue are revealed. It could not be washed away by rains; it could not be overthrown by winds; any wound made upon it was miraculously healed; and the earlier statements as to its physical functions were amplified in sonorous Latin verse.

With this appeared a new legend regarding the Dead Sea: it became universally believed, and we find it repeated throughout the whole mediæval period, that the bitumen could only be dissolved by such fluids as in the processes of animated nature came from the statue.

The legend thus amplified we shall find dwelt upon by pious travelers and monkish chroniclers for hundreds of years: so it came to be more and more treasured by the universal Church, and held more and more firmly—"always, everywhere, and by all."

In the two following centuries we have an overwhelming mass of additional authority for the belief that the very statue of salt

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* For the usual biblical citations, see Genesis xix, 26; St. Luke xvii, 32; Second Peter ii, 6. For the citation from "Wisdom," see x, 7. For the account of the transformation of Lot's wife put into its proper relations with the Jehovistic and Elohistic documents, see Lenormant's "La Genèse," Paris, 1883, pp. 53, 199, and 317, 318.

into which Lot's wife was transformed was still existing. In the fourth the continuance of the statue was vouched for by St. Silvia, who visited the place: though she could not see it, she was told by the Bishop of Segor that it had been there some time before, and she concluded that it had been temporarily covered by the sea. In both the fourth and fifth centuries such great doctors in the Church as St. Jerome, St. John Chrysostom, and St. Cyril of Jerusalem agreed in this belief and statement; hence it was, doubtless, that the Hebrew word which is translated in the authorized English version "pillar," was translated in the Vulgate, which the vast majority of Christians believe divinely inspired, by the word "statue"; we shall find this fact insisted upon by theologians arguing in behalf of the statue, as a result and monument of the miracle, for over fourteen hundred years afterward.*

About the middle of the sixth century Antoninus Martyr visited the Dead Sea region and described it, but curiously reversed a simple truth in these words: "Nor do sticks or straws float there, nor can a man swim, but whatever is cast into it sinks to the bottom." As to the statue of Lot's wife, he threw doubt upon its miraculous renewal, but testified that it was still standing.

In the seventh century the Targum of Jerusalem not only testified that the salt pillar at Usdum was once Lot's wife, but declared that she must retain that form until the general resurrection. In the seventh century, too, Bishop Arculf traveled to the Dead Sea, and his work was added to the treasures of the Church. He develops the legend, and especially that part of it given by Josephus, greatly. The bitumen that floats upon the sea "resembles gold and the form of a bull or camel"; "birds can not live near it"; and "the very beautiful apples" which grow there, when plucked, "burn and are reduced to ashes, and smoke as if they were still burning."

In the eighth century the Venerable Bede takes these statements of Arculf and his predecessors, binds them together in his work on "The Holy Places," and gives the whole mass of myths and legends an enormous impulse.†

In the tenth century new force is given to it by the pious Moslem, Mukadassi. Speaking of the town of Segor, near the salt region, he says that the proper translation of its name is "Hell"; and of the lake he says, "Its waters are hot, even as though the place stood over hell-fire."

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* See Josephus, "Antiquities," 1, 1, chap. ii; Clement, "Epist.," 1; Cyril, "Hieros. Catech.," xix; Chrysostom, "Hom.," xviii, xliv in Genes.; Irenæus, lib. iv, c. xxxi, or cap. l, p. 354, edition Oxon., 1702. For St. Silvia, see "S. Silviæ Aquitanæ Peregrinatio ad Loca Sancta," Romæ, 1887, p. 55, also edition of 1885, p. 25. For legends of signs of continued life in bowlders and stones into which human beings have been transformed for sin, see Karl Bartsch, "Sagen," etc., vol. ii, pp. 420 *et seq.*

† For Antoninus Martyr, see Tobler's edition of his work in the "Itinera," i, p. [illegible], Geneva, 1877. For the Targum of Jerusalem, see citat. in Quaresmius, "Terræ Sanctæ Elucidatio," Peregrinatio vi, cap. xiv; new Venice edition. For Arculf, see Tobler. For

In the crusading period, immediately following, all the legends burst forth more brilliantly than ever.

The first of these new travelers who makes careful statements is Fulk of Chartres, who in 1100 accompanied King Baldwin to the Dead Sea and saw many wonders; but, though he visited the salt region of Usdum, he makes no mention of the salt pillar: evidently he had fallen on evil times; the older statues had probably been washed away, and no new one had happened to be washed out of the rocks just at that period.

But his misfortune was more than made up by the triumphant experience of a far more famous traveler, half a century later—Rabbi Benjamin of Tudela.

Rabbi Benjamin finds new evidences of miracle in the Dead Sea, and develops to a still higher point the myth and legend of the salt statue of Lot's wife, enriching the world with the statement that it was steadily and miraculously renewed; that, though the cattle of the region licked its surface, it never grew smaller. Again a thrill of joy went through the monasteries and pulpits of Christendom at this increasing "evidence of the truth of Scripture."

Toward the end of the thirteenth century there appeared in Palestine a traveler superior to most before or since—Count Burchard, monk of Mount Sion. He had the advantage of knowing something of Arabic, and his writings show him to have been observant and thoughtful. No statue of Lot's wife appears to have been washed clean of the salt rock during his visit, but he takes it for granted that the Dead Sea is "the mouth of hell," and that the vapor rising from it is the smoke from Satan's furnaces.

These ideas seem to have become part of the common stock, for Ernoul, who traveled to the Dead Sea during the same century, always speaks of it as the "Sea of Devils."

Near the beginning of the fourteenth century came a traveler of far wider influence—Sir John Maundeville.

In the various editions of the book ascribed to him, myths and legends of the Dead Sea and of the pillar of salt—old and new—burst forth into wonderful luxuriance. He brings news of a woman changed into an enormous dragon; of a monster who besought a monk to cast out the devil from him, and who had horns on his head, which horns were shown Maundeville by the monk

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Bede, see his "De Locis Sanctis" in Tobler's "Itinera," i, p. 228. For an admirable statement of the mediæval theological view of scientific research, see Eicken, "Geschichte, etc., der Mittelalterlichen Weltanschauung," Stuttgart, 1887, chap. vi.

who told him the story. He gives full details of the phœnix rising from its own ashes. But all culminates at the Dead Sea.

He tells us that masses of fiery matter are every day thrown up from it as large as a horse; that, though it contains no living thing, it has been shown that men thrown into it can not die; and finally, as if to prove the worthlessness of devout testimony to the miraculous, he says: "And whoever throws a piece of iron therein, it floats; and whoever throws a feather therein, it sinks to the bottom; and, because that is contrary to nature, I was not willing to believe it until I saw it."

He of course mentions Lot's wife, and says that the pillar of salt "stands there to-day," and "has a right salty taste."

Great injustice has been done to Maundeville in holding him a liar of the first magnitude. Never was man further from the thought of lying. He simply abhorred skepticism, and thought it meritorious to believe all pious legends. The ideal Maundeville was a man of overmastering faith, and resembled Tertullian in believing things "because they are impossible"; he was entirely conscientious; the solemn ending of the book shows that he listened, observed, and wrote under the deepest conviction, and those who re-edited his book were probably just as honest in adding the later stories of pious travelers.

The "Travels of Sir John Maundeville," thus appealing to the popular heart, were most widely read in the monasteries and repeated among the people. Innumerable copies were made in manuscript, and finally in print, and so the old myths received a new life.*

In the fifteenth century wonders were increased. In 1418 we have the Lord of Caumont, who makes a pilgrimage and gives us a statement which is the result of the theological reasoning of centuries, and especially interesting as a typical example of the theological method in contrast with the scientific. He could not understand how the blessed waters of the Jordan could be allowed to mingle with the accursed waters of the Dead Sea. In spite, then, of the eye of sense, he beheld the water with the eye of faith, and calmly announced that the Jordan water passes through the sea, but that the two masses of water are not mingled. As to the salt statue of Lot's wife, he declares it to be still existing; and, copying a table of indulgences granted by the Church to pious pilgrims, he puts down the visit to the salt statue as giving an indulgence of seven years.

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* For Fulk of Chartres and Crusading travelers generally, see Bongar's "Gesta Dei per Francos," *passim*; also histories of the Crusades by Wilkins, Poujoulat, and others. See also Robinson, "Biblical Researches," ii, 109, and Tobler, "Bibliographia Geographica Palestinæ," 1867, p. 12. For Benjamin of Tudela's statement, see Wright's "Collection of Travels in Palestine," p. 84, and Asher's edition of Benjamin of Tudela's travels, vol i, pp. 71, 72; also Charton, vol. i, p. 180. For Borchard or Burchard, see full text in the "Reyssebuch dess Heyligen Landes"; also Grynæus, "Nov. Orbis," Basil., 1532, folio 298, 329. For Ernoul, see his "L'Estat de la Cité de Hierusalem," in Michelin and Raynaud, "Itinéraires Françaises au 12me et 13me Siècles." For Petrus Diaconus, see "Petri Diaconi de Locis sanctis," edited by Gamurrini, Rome, 1887, pp. 126, 127. For Maundeville I have compared several editions, especially those in the "Reyssebuch," in Canisius and in Wright, with Halliwell's reprint and with the rare Strasburg edition of 1484 in the Cornell University Library: the whole statement regarding the experiment with iron and feathers is given differently in different copies. The statement that he saw the feathers sink and the iron swim is made in the Reyssebuch edition, Frankfort, 1584. The story, like the saints' legends, evidently grew as time went on, but is none the less interesting as showing the general credulity. Since writing the above I have been glad to find my view of Maundeville's honesty confirmed by the Rev. Dr. Robinson, and by Mr. Gage in his edition of Ritter's "Palestine."

Toward the end of the century we have another traveler yet more influential, Bernard of Breydenbach, Dean of Mainz. His book of travels was published in 1486, at the famous press of Schoeffer, and in various translations it was spread through Europe, exercising an influence wide and deep. His first important notice of the Dead Sea is as follows: "In this, Tirus the serpent is found, and from him the Tiriac medicine is made. He is blind, and so full of venom that there is no remedy for his bite except cutting off the bitten part. He can only be taken by striking him and making him angry; then his venom flies into his head and tail." Breydenbach calls the Dead Sea "the chimney of hell," and repeats the old story as to the miraculous solvent for its bitumen. He, too, makes the statement that the holy water of the Jordan does not mingle with the accursed water of the infernal sea; but increases the miracle which Caumont had announced by saying that, although the waters appear to come together, the Jordan is really absorbed in the earth before it reaches the sea.

As to Lot's wife, various travelers at that time had various fortunes. Some, like Caumont and Breydenbach, took her continued existence for granted; some, like Count John of Solms, saw her and were greatly edified; some, like Hans Werli, tried to find her and could not, but, like St. Silvia, a thousand years before, were none the less edified by the idea that, for some inscrutable purpose, the sea had been allowed to hide her from them; some found her larger than they expected, even forty feet high, as was the salt pillar which happened to be standing at the visit of Commander Lynch in 1848; but this only added a new proof to the miracle, for the text was remembered, "There were giants in those days."

Out of the mass of works of pilgrims during the fifteenth century I select just one more as typical of the theological view then dominant, and this is the noted book of Felix Fabri, a preaching friar of Ulm.

I select him, because even so eminent an authority in our own time as Dr. Edward Robinson declares him to have been the most thorough, thoughtful, and enlightened traveler of that century.

Fabri is greatly impressed by the wonders of the Dead Sea, and typical of his honesty influenced by faith is his account of the Dead Sea fruit; he describes it with almost perfect accuracy, but adds the statement that when mature it is "filled with ashes and cinders."

As to the salt statue, he says: "We saw the place between the sea and Mount Segor, but could not see the statue itself because we were too far distant to see anything of human size; but we saw it with firm faith, because we believed Scripture, which speaks of it; and we were filled with wonder."

To sustain absolute faith in the statue he reminds his readers that "God is able even of these stones to raise up seed to Abraham," and goes into a long argument, discussing such transformations as those of King Atlas and Pygmalion's statue, with a multitude of others, winding up with the case, given in the miracles of St. Jerome, of a heretic who was changed into a log of wood, which was then burned.

He gives a statement of the Hebrews that Lot's wife received her peculiar punishment because she had refused to add salt to the food of the angels when they visited her, and he preaches a short sermon in which he says that, as salt is the condiment of food, so the salt statue of Lot's wife "gives us a condiment of wisdom." *

There were indeed many discrepancies in the testimony of travelers regarding the salt pillar—so many, in fact, that at a later period the learned Dom Calmet acknowledged that they shook his belief in the whole matter; but, during this earlier time, under the complete sway of the theological spirit, these difficulties only gave new and more glorious opportunities for faith.

For, if a considerable interval occurred between the washing of one salt pillar out of existence and the washing of another into existence, the idea arose that the statue, by virtue of the soul which still remained in it, had departed on some mysterious excursion; did it happen that one statue was washed out one year in one place and another statue another year in another place, this difficulty was surmounted by believing that Lot's wife still walked about; did it happen that a salt column was undermined by the rains and fell, this was believed to be but another sign of life; did

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* For Bernhard of Breydenbach, see marked pages in the Latin edition, Mentz, 1486, in the White collection, Cornell University, also in German edition in the "Reyssebuch"; for John of Solms, Werli, and the like, see the "Reyssebuch," which gives a full text of their travels. For Fabri (Schmid), see, for his value, Robinson, also Tobler, "Bibliographia," 53 *et seq.*; and for texts the "Reyssebuch," 122b *et seq.*, but best the "Fratris Fel. Fabri Evagatorium," ed. Hassler, Stuttgart, 1843, iii, 172 *et seq.*

a pillar happen to be covered in part by the sea, this was enough to arouse the belief that the statue from time to time descended into the Dead Sea depths—possibly to satisfy that old fatal curiosity regarding her former neighbors; did some smaller block of salt happen to be washed out near the statue, it was believed that a household dog, also transformed into salt, had followed her back from beneath the deep; did more statues than one appear at one time, that simply made the mystery more impressive.

In facts now so easy of scientific explanation the theologians found wonderful food for discussion.

One great question among them was whether the soul of Lot's wife did really remain in the statue. On one side it was insisted that, as Holy Scripture declares that Lot's wife was changed into a pillar of salt, and as she was necessarily made up of a soul and a body, the soul must have become part of the statue. This argument was clinched by citing that passage in the Book of Wisdom in which the salt pillar is declared to be still standing as "the monument of an unbelieving *soul*." On the other hand, it was insisted that the soul of the woman must have been incorporeal and immortal, and hence could not have been changed into a substance corporeal and mortal. Naturally, to this it would be answered that the salt pillar was no more corporeal than the ordinary materials of the human body, and that it had been made miraculously immortal, and that "with God all things are possible." Thus long vistas of theological discussion were opened.*

As we enter the sixteenth century the Dead Sea myths, and especially the legends of Lot's wife, are still growing. In 1507 Father Anselm of the Minorites declares that the sea sometimes covers the feet of the statue, sometimes the legs, sometimes the whole body.

In 1555 Gabriel Giraudet, priest at Puy, journeyed through Palestine. His faith was robust, and his attitude toward the myths of the Dead Sea is seen by his declaration that its waters are so foul that one can smell them at a distance of three leagues; that straw, hay, or feathers thrown into them will sink, but that iron and other metals will float; that criminals have been kept in them three or four days and could not drown. As to Lot's wife, he says that he found her "lying there, her back toward heaven, converted into salt stone; for I touched her, scratched her, and put a piece of her into my mouth, and she tasted salt."

At the center of all these legends we see, then, the idea that, though there were no living beasts in the Dead Sea, the people of the overwhelmed cities were still living beneath its waters, probably in hell; that there was life in the salt statue; and that it was still curious regarding its old neighbors.

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* For a brief statement of the main arguments for and against the idea that the soul of Lot's wife remained within the salt statue, see Cornelius a Lapide, "Commentarius in Pentateuchum," Antwerp, 1697, chap. xix.

Hence such travelers in the latter years of the century as Count Albert of Löwenstein and Prince Nicholas Radzivill are not at all weakened in faith by failing to find the statue; what the former is capable of believing is seen by his statement that in a certain cemetery at Cairo during one night in the year the dead thrust forth their feet, hands, limbs, and even rise wholly from their graves.

There seemed, then, no limit to these pious beliefs. The idea that there is merit in credulity, with the love of myth-making and miracle-mongering, constantly made them larger. Nor did the Protestant Reformation, which now came in, diminish them at first; it rather strengthened them and fixed them more firmly in the popular mind. They seemed destined to last forever. How they were thus strengthened at first, under Protestantism, and how they were finally dissolved away in the atmosphere of scientific thought, will be shown in the following chapter.*

THE LOCALIZATION OF INDUSTRIES.

By J. J. MENZIES.

AMONG the ancient peoples of the far East any exchange of productions was necessarily on a small scale. Means of transport were limited—by land, to the backs of men and animals; and by water, to rivers and such lakes or inland seas as could be safely navigated by small and rudely constructed boats. Most commodities were raised, manufactured, and consumed within very restricted areas, with little division of labor; and excepting naturally abundant agricultural products and domestic animals were, therefore, inferior and expensive, and men could only accommodate themselves to variations in crops by lavish consumption when they were abundant, and by starvation when they were scanty. In later times, the art of navigation was so far improved as to extend trading along the shores of the Mediterranean, and eventually across it, by which means countries situated round about that great inland sea were brought into close communication with each other, a rapid advance in the arts and sciences resulted, countries hitherto little known were explored, a larger exchange of commodities was effected, and surpluses and deficits were made to balance each other. Still later navigation reached to all the shores of the Old World, and finally into the Western hemisphere. With every addition to the field of human knowledge and enterprise there was a corresponding increase in the volume of exchanges and in the variety of manufactures and useful conveniences. Each country and district parted with that which it had in superabundance, or was particularly skilled in producing, for goods that were scarce or wanting to it, or that its own artificers were not accustomed to manufacture.

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* For Father Anselm, see his "Descriptio Terræ Sanctæ," in H. Canisius, "Thesaurus Monument. Eccles.," Basnage edition, Amsterdam, 1725, vol. iv, p. 788. For Giraudet, see his "Discours du Voyage d'Oultre Mer . . . et autres Lieux de la Terre Saincte," Paris, 1585, p. 56a. For Radziwill and Löwenstein, see the "Reyssbuch," especially p. 198a.

The same system of operations continues extending at the present day, and may do so apparently for an indefinite time. Every new country brought under cultivation, every new discovery of the treasures of the earth and waters, every new appliance adding to our powers and to our facilities of communication, and even every increase in itself in the sum of trading operations, forms the basis of new exchanges to mutual advantage; for the greater the quantities the smaller the profit at which it will pay to exchange them. Experience keeps constantly adding to our knowledge of the special advantages of each locality, and every free movement of trade and industry increases the sum of their usefulness to the human race. Scarcity of food can no longer exist among nations that have kept abreast of this economical revolution. The aggregate of comforts and luxuries generally attainable has multiplied enormously, and the mere operations of exchange give directly and indirectly steady and profitable employment to vast numbers. Nor is this freer exchange of commodities and of ideas attended, as many suppose, by increased competition between men and nations, for it is accompanied by a better and more wide-spread division of labor, and men by degrees cease to produce these articles in which they are manifestly at a disadvantage, and the disposal of which entails loss and disappointment. Those who doubt the advantages of this universal, world-wide intercourse and exchange are bound in consistency to advocate the reversion of society not merely to any earlier stage in its development, but to that state of things which preceded its initiation—that is, to pure and simple cannibalism; for an argument that is good against one step in this march of progress is equally good against another. As it is certain, too, that this same movement, in spite of wars and governmental interferences, is constant and resistless, there can be no more important question than how best to conform to and profit by it, which we may learn by observing how men and nations naturally find their most suitable and profitable occupations.

The general principles determining the employment of the soil of different countries and localities are tolerably simple. Common, bulky, and perishable articles are naturally produced as near as possible to the places of consumption, though improvements enabling them to be more easily and cheaply transported render them more available for distant markets. Such are the compression and baling of hay, the conveyance of dead meats in refrigerated chambers, of live animals in specially adapted wagons and steamships, and of ordinary fresh fruits and vegetables by express trains. More valuable articles and luxuries, such as the finer fruits, sugar, tobacco, and cotton, the cost of transport of which is relatively less important, can and often must be produced in localities specially adapted to them at greater distances from the places of their eventual consumption. Dried fruits are more fitted for distant and uncertain markets than green fruits. Other generally esteemed articles, such as silk, tea, and the finer wines, naturally monopolize the limited areas capable of producing them. On the other hand, as almost any part of the world can grow wheat and the ordinary small grains by the employment of a comparatively limited capital, as the cost of transporting them is inconsiderable, as they are not liable to spoil, and as the enormous quantities in which they are handled and the universal competition among producers of them enable and necessitate their being turned over at the minimum profits, the growth of these indispensable staples is left to the newest, the poorest, and the most remote countries, and to those parts of other countries for which no better employment can be found. A decline in the production of these articles is a sign, beyond doubt, of the increasing wealth of a country, and that it has found better employments for its capital and labor. This is especially noticeable in England, Germany, France, and our own Eastern States; and California also, it may be noted, is discontinuing the production of grain as rapidly as she can find a market for her higher class articles. A still more decided move in the same direction is only restrained in England by the uncertainty of the climate, and the consequent danger of devoting too great an area to pasturage, green crops, fruit, or hops, since an excess of drought is adverse to the first two, and an excess of moisture to the others. The future order of cultivation in the United States is dependent chiefly on the development by irrigation of the vast arid regions of the West, and upon the nature of the resources which may thereby be disclosed, as also upon the description and extent of the trade just beginning between our Pacific coast, Japan, China, Australia, and New Zealand, and that to open up later with the East by the Central American interoceanic canal. It is already certain that the convenient position of California for this trade, her variety of climate and elevation, and resulting adaptability for a great choice of productions, insures for her, through the extension of irrigation, a great and distinctive future. If her wine trade be not as yet as prosperous as she could wish, no one need be surprised at this who has remarked the specialties of character in the different European wines, and considered the centuries of labor and application that have been required to evolve these varied types as the most appropriate to their several localities, as also the great capital employed at low rates of interest in maturing these wines and in educating the tastes of consumers thereto. The production of wool on a large scale is a natural resource of mountainous countries and of regions distant from centers of population, as we see in Wales, portions of Scotland, Germany, and the United States. The marked devotion of Australia to this industry is due to the sudden opening of her unlimited territories, to the nature of her climate, suitable for the rearing of sheep, and to her rainfall, too limited and uncertain for profitable cultivation. Added to these causes is her remoteness from other countries, which, making impossible the export of the animals themselves, dead or alive, on an adequate scale, has allowed her flocks to increase almost unchecked.

As we already saw in the case of the common and bulky natural products, so it is with the corresponding class of manufactured goods; they can not well bear a long and expensive carriage, and therefore, other things being equal, are naturally produced as near as possible to their places of consumption. As in the United States there are numerous contiguous deposits of coal and iron, those most convenient to the large centers of population have been in the mean time utilized, both for fuel and for the heavy iron manufactures, rails, pipes, and machinery, that the various purposes of such communities call for on a great scale. When such articles must necessarily be sent to long distances, those points most convenient to water-carriage are naturally preferred for their production. Pittsburgh is a notable instance of this, also the English, Scotch, Welsh, and Australian coal ports, from which this indispensable mineral is shipped to every part of the world. When especially it is desirable for some manufactures to mix the heavier metals of different countries, such operations must necessarily take place at or near some convenient port. Thus, tin mined in Cornwall is taken to Swansea, the nearest port having iron-works, when required for making tin plates, and imported ores are, by the use of the adjacent coal, also smelted there, as well as at various coal ports in the northwest coast of England and elsewhere. The convenience of both coal and iron has made the river Clyde the chief seat of iron ship-building, just as its local timber made Boston that of wooden ship-building. Makers of boilers, engines, and heavy machinery at Manchester, England, have also discovered that even the thirty miles of rail carriage to Liverpool, and the rehandling there, handicap them in competition with Glasgow shippers of the same articles, which is one of the chief reasons for the construction, now in progress, of the Manchester ship-canal. In countries where deposits of coal and iron are comparatively rare, as in France, Germany, and elsewhere, the favored spots necessarily become themselves the chief centers of manufacture and population. Furniture is a rather bulky and expensive article to move about, and its manufacture, for use through a large portion of the United States, has found an appropriate and central position at Grand Rapids, Mich., where the most useful native timbers and water-power are in abundance.

The lighter metal and wood manufactures, the textiles, leather, pottery, and miscellaneous small wares, in which the cost of transport is relatively less important, are determined, as to their location, by a much greater complexity of conditions, and the general rules on this point are subject, in their case, to variation from specially dominant influences. In order to combine the most obvious advantages, they should not be situated too far from a supply of coal and iron, should be convenient to the sources of their raw material, whether home or foreign, and to the markets where their finished products are expected to find a sale. While, too, each article and department of manufacture will usually succeed best around a center of its own, where a skilled and adapted population has become settled, it is still more important that all should be conveniently clustered for mutual assistance. While these conditions are more or less generally complied with in all great manufacturing countries, they are most completely so in Great Britain, partly by reason of its natural facilities, partly owing to the absence of any fiscal interference by their own Government. Thus it may be observed that the location of the cotton manufacture in Lancashire, of the woolen in Yorkshire, and of the lighter metal and miscellaneous in and around Birmingham, is in compliance with those principles, as well as the subdivision and specialization of all these various industries, many of which and similar ones may also be found in Scotland, which, to a certain extent, is a smaller independent center. Subject to necessary geographical differences, the location and arrangement of similar manufactures in the United States and on the European continent follows as nearly as possible the same conditions. Only in New England had we in existence a population capable of successfully undertaking the production of the great variety of those articles when prematurely called for by the imposition of our high protective tariff on their importation; and the situation of that country, in a corner, as it were, of our territory, and without local supplies of coal and iron, is not all that could be desired for the purpose. True, its seaports, convenient for coastwise navigation, its abundant water-power, and its supply of native wool and timber, to a great extent set off these disadvantages, though probably not completely.

The free commercial policy of Great Britain, united with the combination in a small, centrally situated space of country of all the most desirable facilities, marks her out as the greatest of international manufacturing and trading countries. Her manufacturers have perfect liberty to purchase their raw or partially manufactured materials in the best and cheapest markets; and their constant intercourse with all parts of the world keeps them informed of every new invention and resource. Their own home market is one of the most important, and, having no protection therein, they know at once when they are excelled in the production of any article, and whether it is owing to any natural or acquired advantage, so that among them there is very little waste of effort. Extent of capital hitherto undreamed of, ready to back their efforts abroad by investments in every promising enterprise, also enables them to command a preference in many undeveloped and poor countries. Yet it would be a great error to suppose that there do not exist in many other countries advantages sufficient to enable them also to carry on a large export business in manufactured goods. All are able to utilize some native materials and to save the intermediate profits and carriages upon foreign wares, and without doubt there are many wants that are best understood by the native manufacturers. Crippled as their producers are by fiscal restrictions upon their purchases and combinations, several of them are even now able to sell their wares largely to England herself. The artisans of the European continent are willing to work during a greater number of hours daily and for lower wages than those of Great Britain, and the cost of production is thereby diminished; and there are always in each country some advantages peculiar to itself and its population. Thus, France has a specialty in artistic taste, which enables her to supply the English market with most of its silks and ornamental objects, as well as with large quantities of fine woolen fabrics. Germany, the best educated country in the world, excels in applied science, as in the working of metals and stained glass; and the United States in labor-economizing apparatus, such as agricultural, sewing, and printing machines. Belgium has supplied wrought-iron girders for the roofs of English and Scotch railway stations. England also exports large quantities of partially manufactured goods, such as yarns, chemicals, and pig-iron, showing that the importing countries have, in various ways, superior facilities for the finishing processes. She also has need of the co-operation of other countries for the perfecting of her own wares. Thus, the finest flax grown in the north of Ireland, in order to attain its highest quality, must be sent to Belgium to be steeped in the water of a certain river. Returning from there, it is spun into superfine yarns by the best machinery and in the naturally adapted moist climate of Belfast. At that stage the product is again sent back to Belgium, where it is woven into gossamer-like cambrics, in low, damp cellars, and under conditions that would not be agreeable to the north of Ireland artisan, and the work of the Belgian hand-loom weaver must then be carried back to be bleached under the dripping skies of the Green Isle. England is, besides, herself the largest and readiest buyer of all improved articles of necessity and luxury, from whatever source arriving; and, while usually the first to open up new markets, in none does she lay claim to any exclusive privilege.

There is, indeed, ample room in the natural economy of production for the services of all nations, and none need stand idle. Co-operation, not hostility and jealousy, should be the watchword of modern industrial enterprise. We ought, in the interest of producer and consumer alike, to remove all fiscal shackles from our trade and manufactures. European governments, hampered with the expenses of an all-devouring militarism, may be unable to abandon any source of revenue, however demoralizing in its incidence or costly in its collection. They may also fear the effects upon their own stability of even a temporary disturbance of existing employments. But neither of these objections can be of any weight with a nation perplexed only with the disposal of its surplus revenues, and whose reposing might need fear no foreign attack. In the enormous extent of our partially developed territorial resources, and no less in our wealth of inventiveness, now but half utilized, there can be no scarcity of employment for capital and labor, nor can we find any such profitable investment for our hoarded millions as the release of our capitalists and artisans, by just indemnities and pensions, from the demoralizing servitude of state-supported industries. In the past we have misdirected their energies and squandered their resources, and we owe them some compensation. Let us all make a new start by working in alliance with Nature, and no longer in ignorant opposition to her. Let each industry freely settle where it may, in our territory or out of it, and within the lifetime of many already middle-aged we shall see progress in the wealth of our country, and in the growth and contentment of our population, far surpassing all our previous experience.

A NEW view into the conditions and international relations of the remote past is given by Dr. Lehmann, of Berlin, in a paper on "Ancient Metrology." His showing that the Egyptian system of weights and measures, instead of being the origin of that of Babylonia, presupposes the sexagesimal system of the latter, if confirmed, would indicate the existence of commercial intercourse between Babylonia and Egypt at a time of which we have at present no contemporaneous records.

THE EVOLUTION OF THE MODERN RAILWAY BRIDGE.

By Prof. CHARLES DAVIS JAMESON,
of the State University of Iowa.

A BRIDGE is a structure over a river, ravine, or other opening, for the purpose of sustaining a *moving* load. This, in the case of a railroad bridge, consists of a heavy locomotive and train coming on at one end, rushing rapidly over the bridge, and off at the other end. This fact, that the load to which bridges are subjected is a moving load applied for only a short period of time and then removed, is a most important factor to be considered in calculating the necessary strength of the various members, as the strain produced in any piece of material by the application of a load is nearly doubled when the load is applied quickly as compared with that produced by the same load when applied gradually.

Bridges may be divided into the following classes: 1. The beam or girder. 2. The framed truss. 3. The arch. 4. The suspension bridge.

The most ordinary form which we see in this country, and the one most generally used for the purpose of railway bridges, is the framed truss, and that is the one the development of which it is our purpose to show.

The one point to be carefully studied in all bridge construction is economy—that is, to get as much strength with as little material as possible; in other words, the maximum amount of strength with the minimum amount of material.

The simplest method of crossing any opening where the dimensions of the opening are not so great, or the load so heavy, as to forbid its use, is by means of a plank placed from one side to the other, making the plank of such a length that the ends may have sufficient bearing upon each side of the opening (Fig. 1).

Fig. 1

In crossing an opening by means of a simple plank or beam, supposing we make the beam large enough, it answers every purpose and will hold up the required load. But in this there is great waste of material. We will take, for example, a plank twelve inches wide, and three inches deep, over an eighteen-foot opening—that is, the plank would have to be about twenty-one or twenty-two feet long, in order to allow the ends sufficient bearing surface upon the masonry on each side. This plank would hold up a certain amount of weight, but, as the weight is increased, in a very short time the plank would begin to bend and buckle in the center. In order to increase the strength of this primitive bridge, we could place another plank beside it, making the bridge twenty-four inches wide, and, if the passing load were made to bear upon the entire width of this bridge, of course the bridge would bear just twice as much as one plank; but, in order to double the strength of the bridge, we have also doubled the amount of material necessary in its construction, and therefore have not in any way increased the economy.

This system might be carried on to infinity, and almost any amount of required strength be obtained by placing a sufficient number of planks one beside the other. But, returning again to the two planks, instead of placing them one beside the other, suppose we place one plank on top of the other, and nail them together firmly, so that they shall act as one plank (Fig. 2). We then have a bridge eighteen feet long, twelve inches wide, and six inches deep. In this bridge we have exactly the same amount of material we had when the two planks were placed side by side, but we have four times as strong a bridge instead of only twice; that is, we have doubled the amount of material, but we have multiplied the strength by four.

Fig. 2

If one plank would hold up one hundred pounds on the center, then the two planks placed side by side would hold up two hundred pounds; while, placing the planks one on top of the other, and nailing them firmly together, they would hold up four hundred pounds. In this way we see that, in order to increase the strength of the bridge or beam faster than we increase the amount of material, the increased amount of material should go into the depth of the beam and not into the width of it. This is one of the first principles in the resistance of material, that the strength of a beam varies directly as the width—that is, if we make the beam twice as wide, it will hold twice as much; and that the strength varies as the square of the depth—that is, if we make it twice as deep, it will hold up four times as much. If we make it three times as deep, it will hold up nine times as much of a load. So that you can readily understand that, in order to increase the strength of the bridge or beam without increasing the material in the same proportion, the increased amount of material should be put into the depth and not into the width.

We now have a bridge twelve inches wide and six inches deep, which will hold up four times as much as our original bridge, twelve inches wide and three inches deep, and the amount of material is simply doubled. To advance one step beyond this, suppose we take one of the planks and stand it up edgewise, and then place the other plank upon its flat side upon the top of this, as shown in Fig. 3, and nail the planks firmly together.

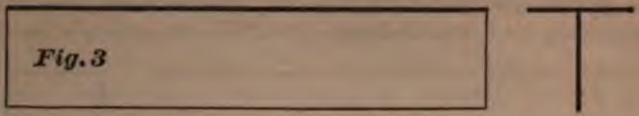


Fig. 3

We now have a bridge twelve inches wide, as we originally had, but fifteen inches deep, or what is known as the T-bar or girder, and the only difficulty about this bridge is the trouble in making it stand up; being so much higher than it is wide, it has a great tendency to tip over. But supposing the planks are made to stand in this shape, which is a simple matter, we then have a bridge fifteen inches deep, which will hold about seven times as much load as the original plank. Of course, if the bridge were made fifteen inches deep and the same width, that is, twelve inches wide, it would hold twenty-five times as much as the original bridge; but by turning one of the planks upon the edge we have increased the depth and decreased the breadth, so that the breadth of the bridge under the top plank is only one fourth of what it was before, and the total strength of the bridge is from seven to eight times that of the original plank. Now, in order to obviate some of the difficulty in making this bridge stand up, suppose we take the plank that is upon the edge and make two planks, each of them twelve inches wide but only an inch and a half thick, and then nail the floor plank upon the edges of this, making an inverted box, as shown in Fig. 4. We then have a bridge that there is no trouble in making stand, as it has twelve inches of bearing surface, and we have the same amount of strength as when it was in the shape of the T-bar, and we have what is technically known as the U-bar or channel-bar.

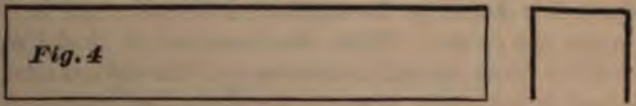


Fig. 4

In this U-bar there is this trouble: that, having the sides only an inch and a half thick and twelve inches deep, there is a tendency to bend in the sides—that is, a tendency to give sidewise; and in order to obviate this we take the top plank and split it in two, making two planks twelve inches wide and an inch and a half thick. Nail one on the top and the other on the bottom: we get what is called a box girder (Fig. 5), and which has about nineteen times the strength of the original three-inch plank and only double the amount of material.

So far we have considered our bridge as being only twelve inches wide. We now wish a bridge wider than this, but with no more material in it except what may be needed in order to make the floor. Suppose we take the top and bottom plank of this box girder, cut them in two lengthwise, making out of each two planks six inches wide instead of twelve, and we fasten these

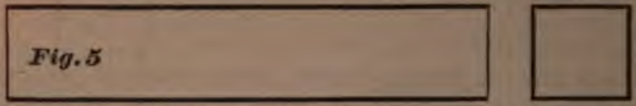


Fig. 5

upon each of the vertical planks, as shown in the drawing. We then have what is technically known as an I-bar, or flanged girder (Fig. 6). Provided these flanged girders are so braced as to prevent their bending sideways, the two flanged girders are of exactly the same strength as the box girder, and, as you see, can be placed at any distance apart, and the floor simply placed on top of them or on the lower flange, and we have a bridge as wide as we wish, with the strength of the box girder.

This I-bar, or flanged girder, is one of the most generally used forms of construction for bridges of short spans.

So far we have considered the material used to be simply wood, but I-bars are now made of iron or steel, and within the last few years entirely of steel, owing to the fact that the improved method of making steel has rendered it even cheaper than wrought iron.

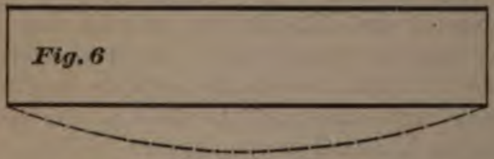


Fig. 6

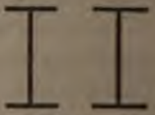


Fig. 6 A.

Let Fig. 6 represent a side-view of the flanged girder, or I-bar, of which Fig. 6 A is an end-view.

Suppose this beam to be supported at each end and a load placed upon the center. Then the tendency of that load would be to bend the beam down in the shape of the dotted line, and, in case the load is sufficient, it would break in that way.

Before the breaking-point is reached the top and bottom of this beam are subjected to totally opposite classes of strain, as you will see. If you bend the beam, the tendency in the bottom of it is to pull the beam apart, or, in technical language, the bottom flange of the beam is in tension—tension being the force which tends to pull apart the particles of the beam. Thus, if you take a string fastened at one end, and hang a weight on the other end, the string is in tension, the action of the weight being to pull the particles of the string apart.

The top flange of the beam is in compression—that is, the particles of which the beam is composed are forced together. It is the same strain obtained if you take a vertical post and put a weight on top of it; that weight tends to force together the particles of the post, and the post is said to be in compression.

It is well to get a thorough understanding of these two kinds of strains, as they are the principal strains that have to be considered in all bridge-building. There is a point between the top and bottom of the beam at which the character of the strain changes from compression into tension, where there is no strain at all, and the amount of strain in the beam decreases from the outside toward the center until this zero-point, or *neutral plane*, is reached; and, as the greater part of the strain comes upon that portion of the beam farthest from the center, you will at once see the economy and necessity of placing as much of the material as far from the center as possible—that is, placing the material where it is going to do the most work, and this is what has led to the adoption of the flanged girder, or I-beam, as a favorite method of construction. The principal part of the material is placed at the two outside edges of the beam where the strain is the greatest, and the amount of material between these two outside flanges is simply enough to keep the flanges apart.

As the size of the opening to be crossed increases, the size of the flanged girder necessary to hold up a given load increases, so that in a very short time the piece of iron or steel necessary becomes so large as to make it almost impossible to handle if it is all in one piece, and also a great deal of the material in the flanged girder is absolutely of no use—that is, a great deal of it can be cut away and used to more advantage in other places.

This leads us at once to the framed truss or framed girder. There is one thing in connection with framed trusses to which I wish to call your attention, and that is, the whole foundation of the framed truss is based upon a triangle. You will readily see the object of this. Suppose four pieces of timber are framed together, as shown in the drawing (Fig. 7), in the form of a square or rectangle. Then any strain coming upon one side of this rectangle tends to change the form of the figure, and, unless the joints are made perfectly stiff, the rectangle is changed to the shape shown in Fig. 8, where every piece is of its original length, and

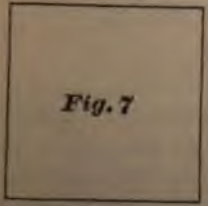


Fig. 7

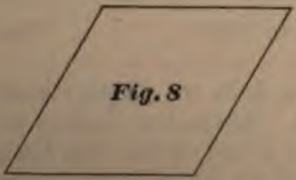


Fig. 8

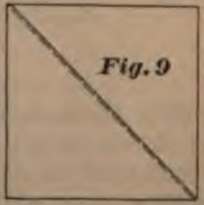


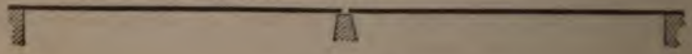
Fig. 9

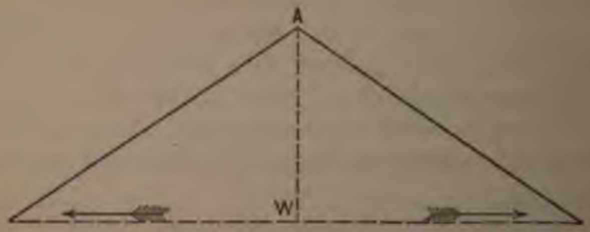
simply the angles have been changed. Now, suppose we divide this rectangle, by means of a brace or tie, into two triangles. Then not one of these timbers can be moved, or the form of the rectangle changed in any way, without lengthening or shortening the diagonal which divides it into triangles, and, therefore, the rectangle with the brace and tie forms a perfectly rigid figure (Fig. 9).

In other words, the triangle is the only figure the form of which can not be changed without changing the length of one of the sides; and thus any truss, to be perfectly braced and able to withstand any strains that come upon it, must be framed so as to be divided into a series of triangles.

Returning to our original beam thrown across an opening, we will suppose that we have a beam long enough and strong enough with the required load to cross an opening eighteen feet wide, and that we have an opening thirty-six feet wide which we wish to cross. That could be done by building a pier in the center of the opening and dividing it into two openings, each eighteen feet, as shown in Fig. 10; but, in the case of a bridge over a road or over a small river, it would not be advisable to block up the way by this pier, and some other method must be found to support the two inner ends of the beams. The simplest plan of doing it is shown in Fig. 11. Taking two beams that are each slightly longer than eighteen feet, we throw them across the opening, as shown in Fig. 11. These two beams meet at the angle, the apex, A, of which is up, and, if the two lower ends are kept from sliding apart, will stand in that position. Now, if from the angle where these two beams meet we let down a rope or iron rod, run out the floor beams eighteen feet long, and connect the inner end of each to this rope or rod, we have a bridge covering an opening thirty-six feet long—that is, one end of each floor beam rests upon the ground, the other end is sustained by the rope or

Fig. 10

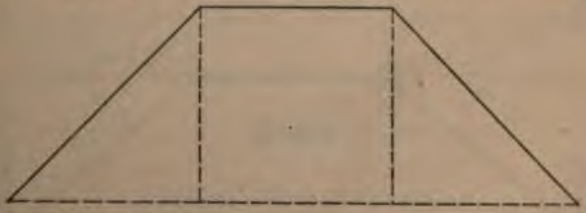




KING POST *Fig. 11*

iron rod, and all the weight upon these ends of the beams passes up the rod, and then comes down the two diagonal beams to the abutments. The one thing necessary in this is that the lower ends of the two diagonal beams shall be so fixed as to make it impossible for them to slip out in the direction of the arrows, and this object is usually attained by making the floor stringers serve as a tie to hold them together. In the drawings, the full black lines are in compression and the dotted lines are in tension. Thus, you see the vertical rod or rope in the center is in tension—that is, a weight being at W, all of that weight comes directly upon the rod and is carried to the apex, A; then half of it passes to each side down the inclined braces, and they are in compression. The tendency at the foot of these braces is for them to slip out in the direction of the arrows. They are held together by the tie-rod or floor stringers, which are in tension. In regard to tension and compression, you may get a better comprehension of them if you understand that a cord or rope can be used for any member of a bridge that is in tension, while a post or some stiff piece of timber or iron is necessary for anything in compression—that is, in all these diagrams the dotted lines could be replaced by ropes or cords, while the full black lines are obliged to be iron or wooden posts or braces.

You thus see that we have the simplest form of a framed truss. This form of truss is called the king-post truss. Now, as the width of the opening increases, the height of the posts would also have to increase, and in a very short time would get so high, and make the inclined braces so long, as to become unwieldy. In order to overcome this, after a certain height has been reached, instead of continuing the king-post higher, we simply cut it off and substitute two posts or rods in its place (Fig. 12). In this the



QUEEN POST *Fig. 12*

length of span that can be covered with the same sized material is one half larger, and the bridge is divided into three panels, as they are called. A panel is one of any number of equal parts into which the truss of a bridge is divided by means of the posts or rods. This second truss is called the queen-post truss; here also the full black lines are in compression and the dotted lines are in tension. As you will notice in this truss, which is also the case in the flanged girder, the top part of the truss and the top flange are always in compression; so the lower chord is always in tension, as the lower flange in the flanged girders. This principle is the same in all framed girders.

Fig. 13

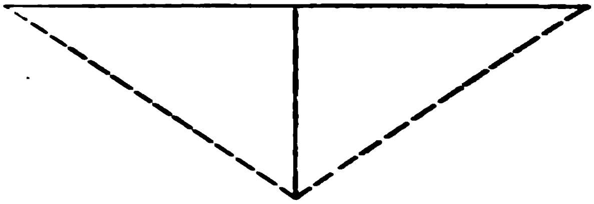
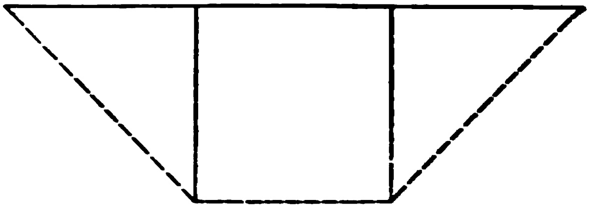


Fig. 14



Either of these trusses can be inverted whenever it is desired, so that the truss comes below the floor, as shown in Figs. 13 and 14; the only difference that it makes is in the character of the strain that comes upon the different members of the truss. The

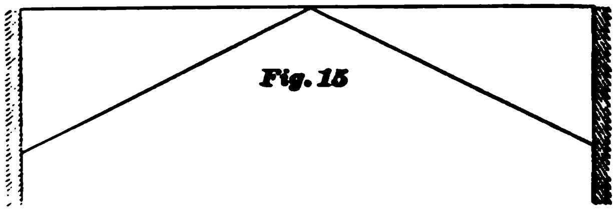


Fig. 15

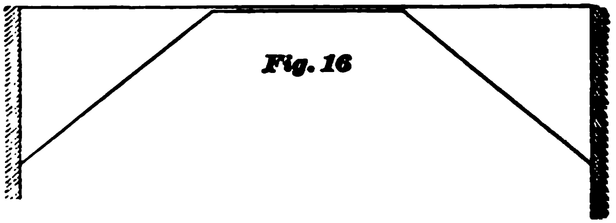


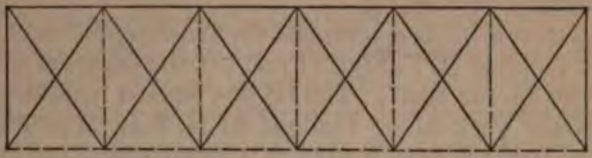
Fig. 16

vertical member in the upright truss is in tension, and
truss is inverted it is in compression, as shown in
The braces become ties, and the floor stringers are

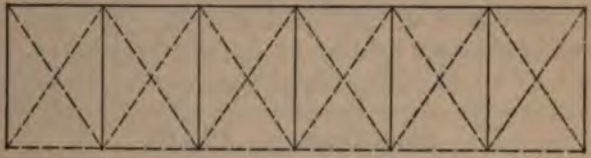
Whenever it is desired to make the floor
the truss, then the bottom chord or
tirely, and the horizontal

abutments (Figs. 15 and 16). There the weight comes directly down from the top of the bracing, and the lower end of the braces are held in place by the masonry abutments.

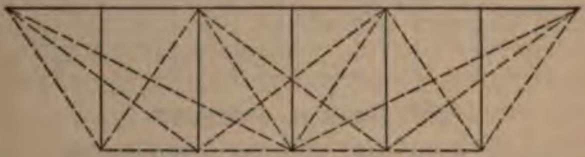
From some combination of these trusses can be constructed any form of bridge, with the exception of the suspension bridge and the arch. By increasing the number of panels or by combining a number of king-post trusses (Figs. 17 and 18), we have what is known as the pony truss, and for short spans one that is used to a great extent on all railroads.



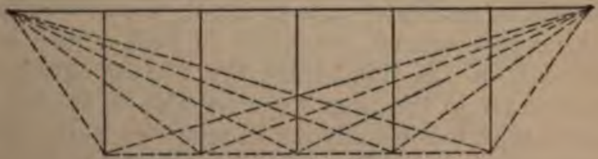
PONY TRUSS. *Fig. 17*



PONY TRUSS. *Fig. 18*



FINK TRUSS. *Fig. 19*



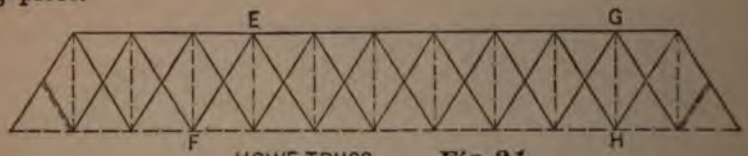
BOLMAN TRUSS. *Fig. 20*

Every bridge is composed of two or more trusses. The ordinary railroad bridge is composed of simply two trusses, one upon each side. These trusses are connected at the top and bottom, and the train can either run over the top of the bridge, or through the bridge on the bottom chord.

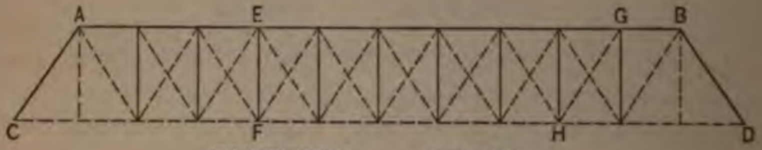
In the pony truss, the only distinctive feature is that the trusses are not deep enough to allow of their being fastened to-[illegible] the top, when the train runs through upon the bot-[illegible]fore they can only be used for very short spans, and it is considerable trouble to so brace them as to keep them in a true vertical plane. These pony trusses, however, when used as a deck bridge, that is, when the train runs on the top, can be braced so as to form a very firm bridge, and practically it is simply a box girder (Fig. 5).

The members of a bridge at the top and bottom of each truss, either horizontal, inclined, or curved, are called chords; that at the top is called the top chord (A B, Fig. 22), the bottom one, the bottom chord (C D, Fig. 22). In the bridges we are considering, they are usually parallel.

The brace or strut is a compression member, and may be either vertical or inclined (E F, Figs. 21 and 22), the object of which is to keep the two chords apart. The tie is a tension member, and also may be either vertical or inclined (G H, Figs. 21 and 22). The lower chord being always in tension is sometimes called the straining piece.



HOWE TRUSS *Fig. 21*



PRATT TRUSS *Fig. 22*

In some types of bridges which we will take up at once there is no bottom chord (Fig. 19). We have what is called the Fink truss. As will be readily seen, it is merely a combination of the inverted king-post trusses, combined in such a way as to suit any required span. In this bridge the bottom chord is not in any way necessary to the proper construction of the truss, but in case of a long span it is usually put in as shown by the dotted line, not in any way to increase the strength of the truss, but simply to add to its stiffness and stability. The Fink truss was invented by Albert Fink, and manufactured for many years by the Louisville Bridge and Iron Company. For short spans, or what are usually called shore spans in many-span bridges, it is a most convenient and economical method of construction, and has been very much used. The top chord is in compression, as shown in the drawing, and is usually made of wood, although this is not by any means necessary. The posts, or vertical compression members, are usually of iron, and the tension members consist of round iron rods, fastened by means of an eye and pin at the ends.

The next form of truss is that known as the Bolman truss (Fig. 20). In this also, as in the Fink truss, there is no bottom chord necessary. The distinctive characteristic of the Bolman truss is that from the lower end of each vertical compression member the tension members run directly to each abutment, differing in this respect from the Fink truss, where most of the tension members run across simply one or two panels of the bridge. In this way any load coming upon the top of one of the panels in the Bolman truss passes down the vertical compression member and is at once carried to the abutments by means of the tie-rods. Theoretically, this bridge is one of the most simple that can be constructed; but when the span becomes of any great length, the length of these tie-rods becomes so great as to render them unmanageable, and within very small limits they become impracticable for that reason. Hence, the Bolman truss has not been used to any considerable extent. By the addition of the bottom chord to support the floor timbers of the bridge, either the Bolman or the Fink bridge can be used as a through bridge as well as a deck bridge, although to achieve the utmost economy in their use they are both eminently deck bridges.

We will now take up the different kinds of trusses that are used in ordinary railroad work, all of which are simply some combination of the king-post trusses, either upright or inverted. The first and most common form in this country is what is known as the Howe truss (Fig. 21). In this the braces are diagonal and the tension members are vertical.

This form of truss has probably been built a hundred times more than any other form that is in use. It is not in every respect an economical truss; but the reason of such general use is the fact that it is one of the most simple to construct. The full lines are those in compression, and are usually built of wood. In the Howe truss, the lower chord, which is in tension, is also built of wood, while the only iron-work about it is the vertical rods and cast-iron blocks for the ends of the post. You will thus see the advantages of this truss in a country where wood is very plenty and iron is scarce. The construction of the iron-work is very simple, and the parts are in pieces, so that they can be easily handled by one gang of men with the ordinary block and tackle. The angle blocks are all duplicates, so that, after a pattern has once been made, a great many similar pieces can be made from it; and this, in the absence of skilled labor or proper shops for doing bridge work, is a great saving of time.

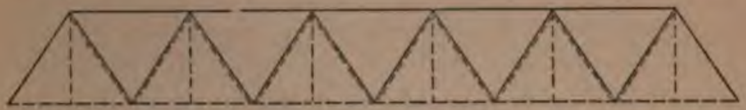
In all Howe trusses a very large "factor of safety" has to be used in order to take into account the uncertain character of the wood. By a factor of safety we mean this: you have a given load which is to be supported by a bridge; if all the material used in that bridge were absolutely perfect, the size of each piece would have to be exactly large enough to bear its part of the strain, and no larger; but as neither in iron or steel, and particularly in wood, can you calculate just exactly how many pounds of strain any particular piece will stand, in order to make it perfectly safe you use, in calculating the size of the bridge members, the load it is to bear multiplied by five, and sometimes even by ten, and then make the bridge theoretically strong enough to hold up this load—that is, five or ten times the amount of load that ever can come on it—and this five, or ten, or six, as the case may be, is called the factor of safety; that is, if all material used in the bridge were absolutely perfect, the bridge would hold up five or ten times as much as ever would come upon it; and wherever a great deal of wood is used the factor of safety has to be very large, as the amount of strain that wood will bear is very uncertain, and varies under different circumstances.

You will readily see that the Howe truss can be used either as a deck bridge or a through bridge, and remember that the Howe truss is the type of bridge that was generally used upon railroads so situated that wood was plenty and iron expensive, and without money enough to send a long distance for iron bridges; and there have been some remarkable examples in this country of the durability of Howe-truss bridges designed by ordinary carpenters without any technical education.

As the price of iron decreased, in a very short time the lower chord of the Howe-truss bridge was made of iron instead of wood, as it was found to be much more economical, and it was then what is called a "combination bridge"; that is, of wood and iron.

The next form of bridge is what is called the "Pratt truss" (Fig. 22). The distinctive feature of this is that the compression members are vertical, while the tension members or ties are inclined or diagonal. In this, the amount of iron, supposing the tension members to be of iron and the compression members of wood, is increased and the amount of wood is decreased. This was a very natural result as the price of iron decreased. In a short time the wooden posts were removed and iron posts substituted for them, and we then have an entire bridge of iron, in which the compression members are vertical and the tension members inclined, and it is the most generally used form of iron bridge in this country; it may be called the typical American railway bridge.

The next form of truss that we will examine is what is known as the Warren triangular girder (Fig. 23). You will see that each of the pieces connecting the upper and lower chords acts both as a tie and a brace—that is, is subject to both compression and tension. The only advantage that can be claimed for this bridge is simplicity and a fewer number of parts than any other form of bridge truss; but by thus reducing the number of parts we have increased the size of the parts that are used, and thus, to some extent, done away with the advantage. Each of the tie-braces, as they are called, crosses one panel, and the bridge is thus divided into bays two panels long. The vertical rods, as shown in the drawing, are not in any way necessary to the theoretically proper construction of the truss, but are simply put in to support the chord between the panel-points and make it able to bear the cross-strain that comes upon it from the floor system, provided the bridge is a through bridge. When the bridge is used as a deck bridge and the floor system laid upon the top chord, there is the same necessity for vertical posts.

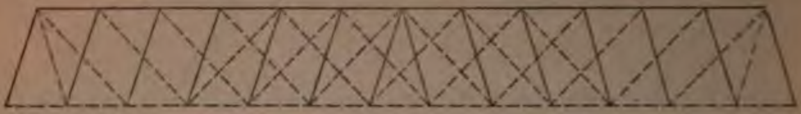


WARREN TRIANGULAR TRUSS *Fig. 23*

In countries where it is possible to procure good timber of large size, the Warren triangular bridge is as economical and convenient a form of truss as can be built. To use it in its most economical manner the lower chord is usually made of iron, as that simply has to withstand tension; but the tie-braces are made of wood, and also the top chord. One point which is to be studied carefully in the Warren triangular truss is the fastening of these braces, as they must be fastened in such a manner that they not only will resist compression, but also that they will act as ties and resist tension. This necessitates a rather more complicated method of fastening.

Another great advantage connected with the use of the triangular truss is the ease with which, when necessary, any piece can be removed and replaced by a new piece without in any way impeding the passage of trains over the bridge during the operation. In the case of wooden or combination bridges this becomes a matter of great importance, as the timber in these bridges is exposed to alternate dryness and moisture, and thus, in a comparatively short time, decays, and there soon is the necessity of replacing the bridge piece by piece; therefore any bridge that is constructed in such a manner as to make this possible, without impeding the traffic on the road, possesses a great advantage over other forms of bridges. The triangular truss is a favorite method of construction on all railroads in the southern part of this country running through that belt where it is possible to obtain, at comparatively slight cost, yellow pine for the requisite timber.

We come next to the last type of bridge that has been used, to any great extent, upon the railways of this country. This bridge is called the Post bridge (Fig. 24), taking its name from its inventor. The characteristic features are that the compression members are inclined at what is claimed to be the most economical angle—that is, the most economical in regard to the amount of strength obtained for the amount of material used. They are so inclined as to cross one panel of the bridge, while the tie-rods, running at an angle with the braces, cross two panels. This is the only advantage that can be claimed for this form of truss, and much of this so-called advantage is more than counterbalanced by some of the difficulties encountered in the actual construction; and whether the bridge really in itself is a more economical bridge than the Pratt, yet remains to be practically proved.



POST TRUSS *Fig. 24*

We stated in the beginning that bridges consist of arches and suspension bridges as well as framed trusses. The relation between the framed truss and the arch will be readily seen by an examination of Fig. 25. Take a truss of the Pratt pattern; then, in place of having the top chord parallel with the lower chord, let the compression members be increased in length, as shown in the drawing, and the top chord take the form of an arch, and we have the bow-string girder. The ends of the arch on each side are simply held together by means of the lower chord, which acts as a tie-rod upon them.

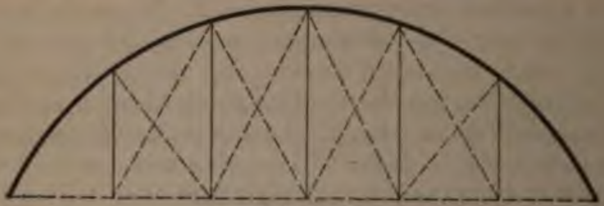
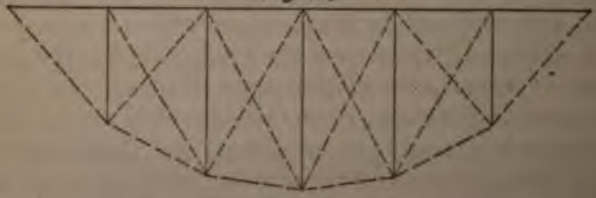


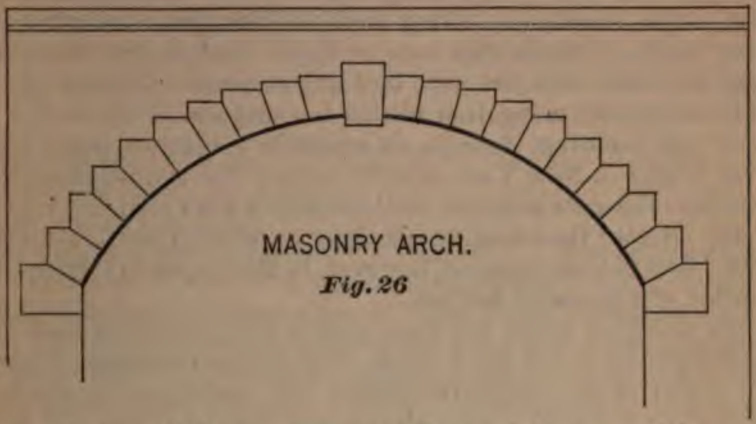
Fig. 25

BOWSTRING GIRDER.

Fig. 27



Now, in the case of a masonry arch (Fig. 26), which has the weight all on top, there is no necessity for the tie-rod to hold the ends of the arch together, for the reason that the ends of the arch are always built so as to abut against heavy masonry which will withstand the horizontal thrust, and thus without the intervention of any tie members we have a perfect bridge by means of the arch, all the weight coming upon the top being passed from one stone to the other in the arch until it reaches the two abutments the same as in a framed truss.


MASONRY ARCH.
Fig. 26

The suspension bridge (Fig. 28) is nothing more or less than the arch turned upside down. In the arch, as we have seen, the only strain that comes upon it is compression; in the suspension bridge, on the other hand, the only strain that comes upon the sustaining member or cable which is stretched between the points of support is tension. In the arch bridge all the weight comes above the arch and presses down upon it; in the suspension bridge all the weight comes below the suspension chains and simply

SUSPENSION BRIDGE.

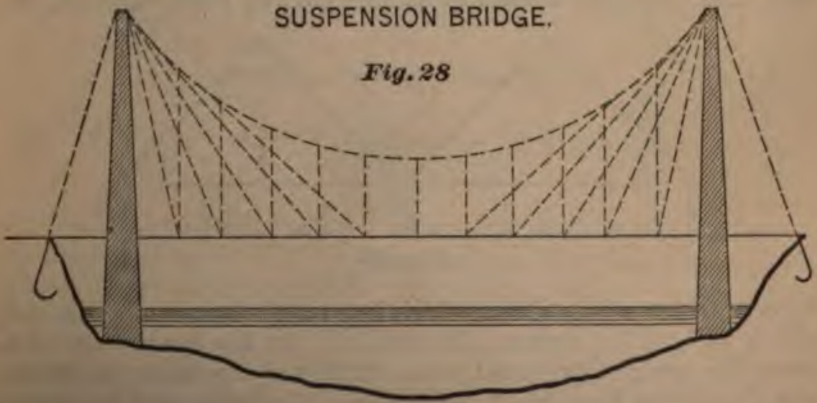


Fig. 28

hangs from them. In the suspension bridge the cables, chains, or any other flexible devices are stretched between the two points of support, the ends carried over the tops of the towers, and firmly anchored in the ground beyond. Then the roadway of the bridge is simply hung by tie-rods from this suspension cable.

The suspension bridge is undoubtedly one of the oldest forms in existence. At the time when our ancestors were either swimming across creeks, or cutting trees, making them fall across in order that they might walk over on them—that is, one thousand years ago—the Japanese were building suspension bridges which are in use to-day, using iron chains for suspension cables, and in every way building them in as scientific a manner as the East River Bridge in New York is built to-day. Of course, there was a certain crudeness as to the methods which were used, but this in no way affected the scientific principles on which the bridges were built. It is not our purpose, however, in this paper to take up the question of suspension bridges.

We pass now to the last form, and in this country at least the latest form, of the framed truss—that is, the cantilever bridge. The object of the cantilever bridge is to make possible the economical construction of long, clear spans of a rigid truss, and thus do away to a great extent with the necessity of suspension bridges, as there are many disadvantages besides the mere one of expense that are connected with the use of suspension bridges. The other advantages of the cantilever will be taken up later.

To show the development of the cantilever bridge, we will take two king-post trusses (Fig. 29); putting them together, we form a bridge of two spans, which has an abutment at each end and a pier in the center. In case this was for the passage of a river, the center pier would come directly in the center, obstructing navigation to a great extent, and otherwise prove an inconvenience. We use the king-post truss merely as the most simple form of truss that is built. In any other form that could be built the result would be the same; that is, for a bridge of two spans there would be a pier in the center of the river, and for any span that could be built of any of the types of bridges which we have noticed thus far the amount of open space that would be left in

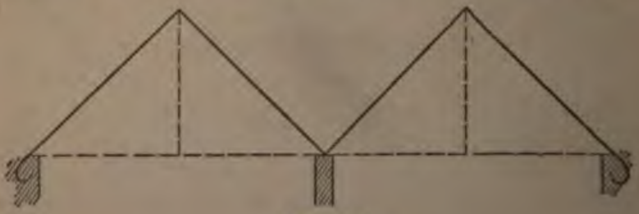
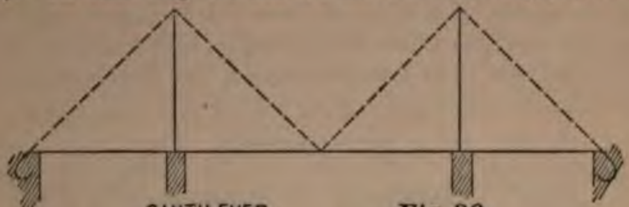


Fig. 29

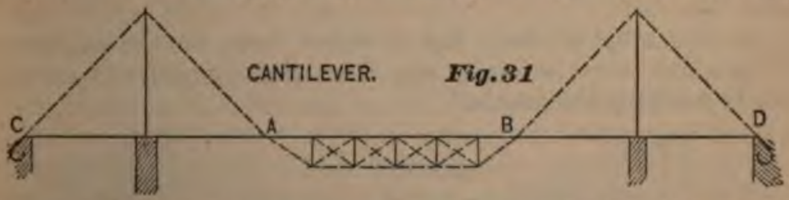
the center of the river may be less than that required by navigation, so that, from what we now have, our only remedy would be the use of the suspension bridge.

In order to do away with this, and make a wider opening in the center of the river, suppose we take away the center pier and replace it by two piers directly under the king-posts of the truss (Fig. 30). In this way we see we have left a large, clear span in the center of the river, and we have in no way increased the amount of material necessary for the building of the bridge, and the two spans that we are using are now balanced, each upon the top of its respective pier. These two spans are fastened together in the center, and the shore ends of both are anchored firmly, in order to keep them from tipping up whenever a load comes upon the river end. We thus see that we have doubled the clear span in the center of the river, and we have what is called a cantilever bridge; that is, a truss supported at one end, and extending out over an opening, there being no support under the other end.



CANTILEVER. *Fig. 30*

Now, suppose it was desired to make this center opening still larger, we have simply to move the piers apart (Fig. 31). We have our two cantilever spans. The shore end of each is firmly anchored down, and the two other ends, A B, project simply into space. If we build thus, the two ends, A B, are firmly fixed and can not in any way yield to the load that may come upon them. If we now construct an ordinary framed truss, of either the Howe, Pratt, or any other type, and instead of putting this truss upon two piers or abutments we simply hang it between the two ends of the cantilever spans, A B, which are projecting over the river, the weight of this truss will be sustained by the tie-rods from the king-posts, or in the case of the cantilever that run over the tower and are anchored down upon the other side. We thus see that by increasing very slightly the amount of material used



in the construction of the bridge we have an open, clear span in the center three times the width that would be possible with the ordinary framed truss, and we have what is known and has lately become famous as the cantilever bridge. The spans C A and B D are called the cantilever spans, and A B the suspended span.

The variations in the cantilever bridge are almost infinite, although the principles in all of them are the same. In the place of using the upright truss, for example, this truss can be turned over, and the ties then become braces, the floor comes upon the top, the shore ends being firmly anchored in place, and, the suspended span held in place, we have a cantilever of the type that has just been erected across the Hudson at Poughkeepsie (Fig. 32), while the first example given you is the type of cantilever that crosses the St. John River at St. John, New Brunswick (Fig. 31).

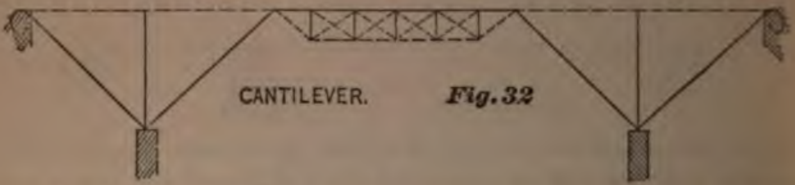


Fig. 32

Then, when a greater length is desired and increased strength, as in the case of the bridge across the Frith of Forth, in Scotland, we simply combine the two, putting the two king-post trusses base to base, and hanging the suspended truss between (Fig. 33).

In that way we have the strongest form for the cantilever bridge, and there is hardly any limit to the length of span that can be made by this method.

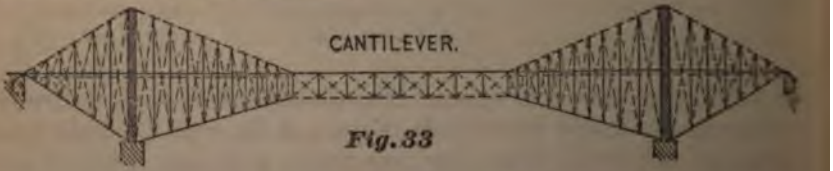


Fig. 33

The advantages gained by the use of the cantilever for long-span bridges are as follow:

As a substitute for the suspension bridge it is, up to a certain length of span, less expensive, and it can be given great rigidity and stability which are impossible in the suspension.

As a substitute for the ordinary framed truss it has the advantages of not requiring any false works for its erection. In the erection of the ordinary bridge there must be built first a timber frame or staging between the piers to sustain the weight of the different parts of the bridge while it is being put together. This is a great expense; and in some cases, where the bridge is far above the water, the current very rapid, or an existing necessity of not obstructing the water-way, becomes impossible. In the erection of a cantilever, each cantilever span is balanced on its own pier and built out each side from the tower in such a manner as to preserve this balance until the shore ends are anchored firmly, after which the river ends can be extended as far as desired. The suspended span, which is never of extraordinary length, can usually be built directly from the ends of the cantilever spans, and the necessity of false work entirely done away with.

In all bridges of long span that the weight of the bridge itself is by far the greatest load that the bridge has to bear. In bridges of short spans, the weight of the locomotive and train coming upon them suddenly constitutes the greatest load, as the weight of the train is greater than the weight of the bridge itself; but as the size of the bridge increases, its weight increases very rapidly, and the weight of the locomotive and train becomes almost nothing as compared with the weight of the bridge itself; that is, if any of these long bridges are built strong enough to hold themselves up, with a very slight margin of safety above that, there is scarcely any danger of their ever falling from any weight that could come upon them from an outside load. For this reason, in building short-span bridges, the amount of economy that can be exercised in the use of material is very small, as the bridge must be built stiff and rigid, even if this necessitates the using of much more material than the absolute weight of the tender and locomotive that come upon it would demand. For this reason plate girders or flanged girders have many advantages connected with their use for short-span bridges, because the whole amount of material used is comparatively of little value, and extreme stiffness and rigidity are the result; while in the case of long-span bridges, such as cantilever, or any remarkably long bridge, every calculation must be made with the greatest care in order to reduce the amount of necessary material as much as possible, because by reducing the amount of material used the weight is reduced, and that again reduces the amount of material. The factor of safety to be used can be only two or three in long-span bridges, while in short spans it should run up even to ten.

Although cantilever bridges are of rather recent use in this country and in Europe, and much has been written claiming them as an invention of modern times, still, the same can be said of them that was said of suspension bridges—that there at present exists in Japan, built by the order of the Mikado two hundred and fifty years ago, as perfect and scientific a cantilever bridge as any that are built in this country or in Europe; and in this way, as in many others, the Japanese show that two or three hundred years ago they had advanced to a wonderful degree in the study of applied mechanics and the "strength and resistance of material." The only trouble is, that they stopped advancing for two or three hundred years, and up to ten or twenty years ago were not as far ahead as two hundred years earlier.

In closing, I wish to call your attention for a few moments to some of the differences that exist between the American and English practice of bridge-building, and the causes that have led to these differences. The characteristic difference is in the methods used in joining together the different parts of the bridge. American bridges, as a class, are pin-connected—that is, the different members, when possible, are joined by means of a steel pin passing through holes in the ends of the pieces. These joints are perfectly flexible, and each member is designed to do its own particular work. English bridges, as a class, have "riveted connections"—that is, the members are fastened rigidly together, and each member is designed to act simply as a part of a rigid, inflexible whole.

The causes that have led to this difference are as follow: In the construction of bridges the English engineer started with the flanged girder of cast or rolled iron, or some other form of a stiff beam, and as the bridges increased in size so as to necessitate the framing of a truss, his whole effort was directed toward making that truss as nearly similar to the original flanged or box girder as possible. This led to perfect rigidity at the joints.

The American engineer, on the other hand, had very little or no iron and steel to work with, and of necessity used wood. As the necessary bridges were of considerable span, the only possible solution of the problem was the pinning together of small pieces of wood so as to form a connected series of triangles. The joints in wood could not easily have been made rigid, and it was not desirable that they should be, as the strength of wood is very slight when the strain is applied in any direction other than in the direction of the fibers of the piece, and the use of the pin joint, theoretically at least, insures this line of action. There has been much ingenuity displayed by our engineers, in the years gone by, in the combinations of triangles used in bridge-designing, and in many cases this has led to absurdities. The whole tendency, however, at present in American practice is to extend the use of riveted joints, and in English practice to extend the use of the "pin connections." Both are working in opposite directions, but from opposite sides, and therefore toward the same point.

One great drawback to the more general use of pin connections by English engineers is the immense first cost of the plant necessary to do the work. Our bridges are usually designed and built by the same company, so that the design within certain limits corresponds to the available plant of the manufacturer, and the expensive tools can be used over and over again. In English practice, however, the bridges are designed according to the ideas of the individual engineer, and then some firm has to build them in all their details to correspond with the design. If the construction necessitates expensive machinery and tools, no company would undertake them at any reasonable cost, as there would be very little chance of any other similar design being offered upon which they could use the same tools.

In riveted work, however, the tools required are within certain limits the same, regardless of the details of design. Pin-connected bridges are much more economical for large work than riveted ones; and this fact, taken in connection with the unrivaled facilities we have for doing the work, accounts for the fact that in the building of large bridges American firms can underbid any others, and not in any way lower the character of the work done.*

* * *

AGRICULTURE AND THE SINGLE TAX.

By HORACE WHITE.

I.

IN the second half of the eighteenth century there arose a school of thinkers in France to whom, at a later period, J. B. Say gave the name of physiocrats. The founder of the school was François Quesnay. Turgot was one of his disciples, and was the most distinguished member of the group. De Gournay, the elder Mirabeau, Morellet, and Dupont de Nemours are well-remembered names of the physiocratic school. Adam Smith was in Paris in the year 1764, and was much in the society of Quesnay and his friends. The exchange of thoughts among these great men must have been mutually beneficial, but the question that has since been raised and discussed with some heat, whether the author of the "Wealth of Nations" gained more from that intercourse than he gave in return, is a barren controversy.

At that time governmental interference with the business and livelihood of the people was incessant and almost universal, and was generally acquiesced in. The doctrine that money was the only form of wealth was held by nearly all statesmen and traders, and had resulted in the establishment of the so-called mercantile system. The physiocrats taught the contrary of both these conceptions. They held that governmental interference with the gainful occupations of the people was bad for both government and people, since it hindered the increase of wealth and the productiveness of taxes. They maintained that money was not wealth except in a secondary sense, as a tool and instrument of exchange, since all persons who acquire money find it for their advantage immediately to lay it out for other things. These two contentions of the physiocrats constitute their claim to the admiration of mankind.

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* Lattice riveted bridges and double intersection trusses have not been discussed, as their introduction would only have o[illegible]ured the object of the paper.

In regard to the advantages of t[illegible] American pin-connected bridges for long spans, we may say that from the most recent [illegible] the time required for the erection of the bridge, after everything is ready, is only abo[illegible] one twentieth of that required for the erection of the English riveted bridges.

They had another doctrine by which, as it has turned out, they are now more generally distinguished. They held that land was the only source of wealth, and that all occupations except agriculture were unproductive.

Agriculture, they said, yielded a "net product" over and above the wages of the cultivator during the time he was engaged in producing the crop. This net product went to the landlord, and might rightfully be taken by the Government to the extent necessary to defray the public expenses. They accordingly proposed and advocated the *impôt unique*, or single tax, on the income derived from landed property. The residue of the net product remaining in the landlord's hands after the payment of taxes was, in their judgment, the annual and sole increment of the world's capital and stock in trade for the upbuilding of civilization.

All other trades, such as manufacturing and commerce, were *sterile*. These served as the clerks, the agents, the porters of agriculture. If any of these saved anything from their earnings as the handmaids of agriculture, competition would cut down their gains, so that eventually they would have nothing left over at the end of the year.

Adam Smith agreed with the physiocrats in their views respecting governmental interference with private business, and as to the true character and functions of money. He differed from them as to the "net product." He held that land was not the sole source of wealth, but that all useful labor was to be reckoned, equally with agriculture, among the sources. His answer to the physiocrats is embraced in Chapter IX, Book IV, of the "Wealth of Nations." Notwithstanding an occasional subsequent flicker, it may be said, speaking broadly, that if there ever was any economic conclusion upon which the world had agreed it was that the physiocratic docrine of net product and single tax was *erroneous*.

II.

This consensus of opinion held good for something more than a century. In the year 1879 Mr. Henry George published his "Progress and Poverty," in which he revived the single-tax idea with some variations. Mr. George says that he arrived at his conclusions by independent reasoning, without knowing anything of Quesnay or his doctrines ("Progress and Poverty," p. 381). The only practical difference between Mr. George and the physiocrats is that he would take all the "net product" for public use, while they would take only so much as might be required for the purposes of economical government. There are differences of reasoning between them, but this is the only difference in results.[*]

Mr. George's latest commentator, Mr. Samuel B. Clarke,[†] allows that the net product may turn out to be a net deficiency as regards the full support of government. In one of his opening paragraphs he says:

"He (George) assumes, without conclusive evidence, that economic rent in the present state of this and every civilized country largely exceeds the amount required for necessary governmental expenses. The assumption, however, is not essential to his scheme. If the amount realized by the proposed tax would not support the Government, of course there would have to be taxes on other things; but the amount to be raised would be less by the amount of the land-value tax."

If we could settle this question of the sufficiency of economic rent to sustain all the costs of government in advance of actual experiment, much would depend upon what we should call necessary governmental expenditures; much would depend also upon what we should take for the basis of economic rent. The latter is defined by Mr. Clarke as "the fair rental value of land exclusive of distinguishable betterments." Buildings, fences, and growing orchards are distinguishable betterments. Perhaps roads and ditches made at the sole expense of the land-owners may be so considered. But are clearing, grubbing, breaking, marling, grading, and like ameliorations distinguishable? If so, we have Henry C. Carey's word for it that no farming district or county or township will sell to-day for as much as it has cost to bring it to its present state of productiveness. I do not agree with Mr. Carey in this. I only mention it to show what a chasm of divergence will open whenever the Government shall undertake to define distinguishable betterments and separate them from undistinguishable ones for the purpose of securing what Mr. Clarke calls "a firm foothold" for the inscribing of the fair rental value of each piece of land in the public accounts. Still, this difficulty may not be insuperable.

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[*] In the "Forum," September, 1889, Mr. Thomas G. Shearman, one of the most distinguished members of the single-tax party, holds that it is not necessary to push the single tax beyond necessary governmental expenses. The absorption of the entire ground-rent, he says, "is not a practical question at present, and will not be for a long time to come, *if ever*." This marks the recent divergence between Mr. George and the "Standard" on the one hand, and the Rev. Mr. Pentecost and the "Twentieth Century" on the other. With the latter the single tax is a cult; with the former it is now only an economic doctrine, or at most a "pious opinion." But certainly "Progress and Poverty" teaches a cult, if it teaches anything.

[†] "Current Objections to the Exaction of Economic Rent by Taxation considered," by Samuel B. Clarke, of New York; pamphlet edition, 1889.

I propose to examine Mr. Clarke's pamphlet rather than Mr. George's book, because the former, although drawn almost wholly from the latter, embraces in small compass and with eminent fairness all that is needed to set out the single-tax argument, and does not lure us into by-ways as Mr. George often does.

"Why should land be singled out, and its holder made to bear a burden from which the owners of other sorts of property are exempt?"

This question is answered by Mr. Clarke, first on economical and then on ethical grounds. On economical grounds: "Because (1) material progress in a community where absolute private property in land is maintained by law, acts, by force of that fact, like a wedge thrust midway into the social structure, to raise a few without effort or merit on their part, and to grind down the masses of men, however meritorious they may be; and because (2) property in land being qualified in the way proposed, poverty will be abolished for that increasing class in civilized communities who are willing to work, but have few opportunities to do so advantageously."

We are not authorized to infer from this statement that in a community where absolute private property in land is maintained by law, e. g., the United States, "a few" belonging to the landless class never get unduly elevated, or that land-owners never get ground down, in both cases regardless of merits, or out of all proportion to merits; nor can we infer that in a community where the state is the landlord, e. g., British India,* a few are never elevated and the masses never ground down, regardless of their merits respectively. But we may fairly demand that the writer shall point out his "few" before he asks us to accept his statement. Do land-owners in the United States get rich faster than other people? To say that the Astors are very wealthy, and that they have their counterparts as land-owners in all our lesser cities, does not answer the question, because the Vanderbilts, the Havemeyers, the Drexels, the Rockefellers, the Carnegies, the Armours, and the Pullmans are also very rich, and they do not own land to any large extent. Can anybody point to a similar group of rich men whose income is derived from agricultural land?

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* De Laveleye, in his work on "Primitive Property," gives the reason for holding that the state is the real landlord in India. "Where the land-tax rises so high," he says, "as to absorb nearly the whole produce and to leave the cultivators only the bare means of subsistence, it is obviously an actual rent that is paid; and if it is the state that receives such a tax, it may be considered as the true proprietor."

Any man of fair intelligence can answer the question for himself. The opportunity has been open to me, for example, to get rich by land-owning ever since I arrived at man's estate. It has been open to me to acquire land at all prices, from nothing per acre upward. I was once domiciled for a short time at a place where land was obtainable at the former price—good arable land, underlaid by a workable vein of coal. I filed an entry on one hundred and sixty acres of it at the United States Land-Office at Lecompton, Kansas; but, happening to receive an offer of twenty-five dollars per week to work on a newspaper shortly afterward, I abandoned my claim, and I am sure that I made no mistake in the point of view of dollars and cents. I took up my abode in the city of Chicago when there were only sixty thousand inhabitants there. The growth of that place has been, since that time, one of the remarkable phenomena in the world's history, and a great part of this growth took place under my eye; yet I have never seen the time when I thought I could make better use of my small capital by becoming a land-owner than by following other pursuits. But I have had some experience as a land-owner. The land that I have at one time and another owned, whether urban, suburban, or agricultural, or taken altogether, has not served me as well on the whole as other investments.

I make this personal reference because I know that my experience tallies with that of many others. Mr. Henry George, for example, has fairly earned all that he possesses of this world's goods. I venture to ask whether the same amount of labor, diligence, and foresight that he has bestowed upon his own vocation of book-writer, journalist, and publisher, if applied to the acquisition and use of land, would have netted him as much. Undoubtedly both he and I, by the use of hind-sight, can see where we might have made larger gains by becoming land-owners than we have ever made. But so, too, by the use of hind-sight we can see how we might have made as much or more in still other ways. We might have invented a telephone, for example.

Before proceeding it should be noted that Mr. Clarke expressly repudiates the idea that the single-tax argument rests upon the idea of an "unearned increment." The rise in land values due to the growth of population has nothing to do with it, or at most only serves to set it in a more glaring light.

"The argument for the land-value tax" (he says) "is very apt to assume the form, and, if we may judge from current criticism, is quite generally understood to have the form, that because the value of land increases without effort on the part of the landholders as the community grows, therefore the community has earned such value, and may justly take it for common purposes. In that form the argument is fallacious beyond question."

Land, he shows, is subject to decrease as well as to increase of value, and other kinds of property increase or decrease in value quite independently of the owner's exertions, merits, or demerits.

The second economical reason why land should be singled out and its holder made to bear a burden from which the owners of other sorts of property are exempt, as stated in the quoted paragraph, is "because property in land being qualified in the way proposed, poverty will be abolished," etc. No mode or process by which poverty is to be abolished being furnished, we are at liberty to infer that, if a marked addition were made to the land-tax all over the country, the poor would soon find themselves in easier circumstances; and that if successive additions were made, they would become more and more prosperous; and that when the whole rental value had been taken, there would be no poor people anywhere.

Now, taxes on land are paid by land-owners (I believe that Mr. George agrees to this). The proposition then is, that if land-owners were required to pay into the public treasury as much as they could by any possibility pay, other people would be so much benefited that even the poorest people in the world would be in comfortable circumstances.

The only way that this great change can be brought about is by the abolishment of all other taxes. I do not undervalue the relief that would accrue to industry from the abolition of indirect taxes. I hold that it should be the first step toward the elevation of the poor man, and the bettering of his condition, to let him have and enjoy what he earns—all of it, except just sufficient to keep him watchful of tax-eaters and tax-thieves.

But suppose that Divine Providence should bestow upon us rulers who could carry on government without any taxes whatever. Would that dispensation abolish poverty? Those who think so are bound to tell us how.

The single-tax philosophy does not propose to constitute a fund for general distribution. If anything should be left over after defraying all necessary expenses of government, the residue is to be applied to the common benefit and delectation through free libraries, music halls, picture galleries, higher education, etc. There is to be no alms-giving, because there are to be no poor. I take it that the utmost good to be derived from the exemption of all others than land-owners from taxation would be gained equally by any device or dispensation which should enable government to be carried on without taxes. I protest against the assumption that this would abolish poverty, unless those who hold that it would shall offer us something more conclusive than their private opinions.

III.

The ethical reason why land should be singled out exclusively for purposes of taxation is based upon what are called "natural rights." I quote Mr. Clarke's words:

"The second answer, in substance, is: Because land is not rightfully the subject of absolute property, and because the injustice of allowing it to be so acquired and held will be remedied by the exaction and application to common uses of economic rent.

"The standard of right, to which this answer appeals, is that conception of inherent or underlying rights which is usually described, perhaps not altogether happily, by the phrase natural rights."

General Francis A. Walker, in his "Land and its Rent," disposes of the dogma of natural rights as applied by Mr. George with a few words of sarcasm, which really do embrace the true philosophy of the subject. He says that as he has never lived in the state of nature himself, but has passed his whole life in communities more or less civilized, he does not feel moved to discuss the subject on any other than economic grounds. According to my observation, more people of fair intelligence are taken in the single-tax net by this dogma than by all others together; and even when they are shaken from every other, they still cling to this as a sheet-anchor. It is worth while, therefore, and indeed necessary, to give some particular attention to it, in an elementary way.

Having cautioned us against the use of the phrase "natural rights" as not altogether happy, Mr. Clarke proceeds to use it twenty-one times in the next twenty pages, as though it were as happy as possible, assuming in all cases that every person born into the world has a natural right to land and a natural right to the best land—conditioned, however, upon every other person's equal right to the same land. The only way to make these conflicting natural rights effective is to confiscate economic rent through the taxing power.

What are "natural rights"? Let us test them for a moment by the Socratic dialogue, the interlocutors being A and B:

A. When you speak of natural rights, you mean rights according to nature, I suppose?

B. Undoubtedly.

A. And that the origin of such rights is traceable to the state of nature?

B. Certainly.

A. What would be the opposite of a state of nature, regarded as an origin of rights?

B. Art, convention, agreement, law.

A. Then the opposite of natural rights would be artificial, conventional, and legal rights?

B. Not the opposite exactly, but the counterpart and supplement of such rights.

A. But as to their origin only, you would say that the two origins were opposite to each other, the one being according to nature and the other not according to nature?

B. Yes, that would be a fair statement.

A. How do we learn whether anything is according to nature, so as to distinguish it from things not according to nature?

B. By observing what takes place in a state of nature.

A. So, if we saw a wolf devouring a sheep in a forest, we should say that it was the nature of wolves to kill sheep?

B. Of course.

A. But if we saw a dog guarding a flock of sheep and driving them into a sheep-fold at night, should we say that it was the nature of wolves to kill sheep, but the nature of dogs to protect them?

B. No, we should say that the dog had been trained to take care of sheep, although his ancestors had themselves been sheep-killers.

A. Why should we say this?

B. Because we know it by observation and testimony.

A. Do observation and testimony teach us that in a state of nature all men have equal rights?

B. We do not know exactly what is the state of nature applicable to man, since he has improvable faculties and is always changing, or is susceptible of change.

A. Yet the hypothesis is that equal rights are according to nature—that is, to man's nature. Are we to say that natural rights exist because there is no state of nature for man, as there is for dogs and wolves?

B. Although man has improvable faculties and is susceptible of change, and although his actual state of nature is hidden from us in the darkness of ages, before written language existed, yet it is possible to approximate toward the state of nature by observing what takes place among those tribes that are nearest to the state of nature.

A. And do we observe that among such tribes equal rights exist as to life or liberty, or any kind of property?

The colloquy would "naturally" come to an end at this point, because, in a state of nature, might makes right. The natural man takes what he wants, wherever he can find it. He takes the weaker man's wife or property, and kills or enslaves him, as the case may be.[*] It is safe to say that this has been the state of man in all countries "ere human statute purged the gentle weal."

The village community, in which the land was held in common for the villagers (not for everybody), was the outgrowth of law, of art, of convention; but even this was subject to the law of the strongest, in the sense that every village community was liable to be dispossessed by any wandering tribe better armed, or more numerous or braver, that might suddenly emerge from the neighboring forest or mountain. The feudal system displaced the village community because the village could not protect itself against armed robbers.[†]

The recent searching examination of "natural rights" by Prof. Sumner[‡] renders it unnecessary for me to go more deeply into this branch of the subject. What are commonly and loosely called natural rights are the outcome of centuries of hard knocks, the results of training, education, and experience, *the very flower and last refinement of art as applied to society and government.* Mr. Clarke cites certain decisions of the Supreme Court to show that natural rights have "their seat in the bosom of God and their voice in the harmony of the world," to quote from Hooker's definition of law. But all such opinions are *obiter* to this discussion. That *our* ideas of natural rights, civilized though we be, change greatly in the progress of time, is proved by our own recent history, the right to liberty having been denied by a majority of Americans within our time.

Conjoined to the doctrine of *natural* rights, though not a necessary part of it, is the doctrine of *equal* rights, which I share as fully as anybody. But, if I attempt to draw generalizations from it, I am confronted by the fact that it is not universally held, but is really confined to a small portion of the human family. The

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[*] The movement now in progress for the suppression of the African slave trade has shed an abundance of light (if any more were needed) on the subject of "rights" as they actually exist in the state of nature. The prime difficulty there is not Arab slave-dealing, but the practice prevailing among the native tribesmen of enslaving each other for the purposes of human sacrifice in their religious ceremonial. Arab slave-dealing is not the cause of African slavery, but merely an adjunct to it.

[†] "Not to be killed," says Stendhal, "and to have a good sheepskin coat in winter, was, for many people in the tenth century, the height of felicity"; let us add, for a woman, that of not being violated by a whole band. When we clearly represent to ourselves the condition of humanity in those days, we can comprehend how men readily accepted the most obnoxious of feudal rights, even that of the *droit du seigneur*. The risks to which they were daily subject were even worse. The proof of it is that the people flocked to the feudal structure as soon as it was completed. In Normandy, for instance, when Rollo had divided off the lands with a line, and hung the robbers, the inhabitants of the neighboring provinces rushed in to establish themselves. The slightest security sufficed to repopulate a country. (Taine's "Ancient Régime.")

[‡] "Popular Science Monthly," July, 1889.

Hindus, for example, hold that rights ought to be apportioned according to caste. In the Mohammedan world the doctrine of fate completely overtops and stifles the doctrine of equal rights. A considerable portion of the human race hold that women have no rights. A majority of the civilized races hold that woman's rights are inferior to man's rights, and we ourselves do not consider them embraced in the term "popular sovereignty." Yet they are one half of the human race, and the more meritorious half.*

I shall assume, without further argument, that the rights of life, liberty, and property, including land, all rest upon *experience*, translated, after infinite trouble, conflict, and bloodshed, into *law*, and this notwithstanding any opinions of the Supreme Court that can be quoted to the contrary.

A title to anything, land or personal property, is defined to be "a just cause of exclusive ownership," and a title-deed is the accepted evidence of the same. The law tells us what shall constitute just cause of exclusive ownership and what shall constitute good evidence of it. It is the same law, as to its origin, that fixes, prescribes, defines, and enforces all rights.

The law has prescribed in this country the following among other things: (1) That human life shall not be taken except in self-defense or by due process of law; (2) that private property shall not be taken for public use without just compensation; (3) that slavery or involuntary servitude shall not exist except as a punishment for crime—this is placed last because it was enacted last.

On the ground of *salus populi suprema lex* the state holds command over the lives and fortunes of its citizens, and to this sovereignty land forms no exception. The state may draft the citizen into its army or navy, and send him into battle where he may be killed. It may likewise take his landed property or his personal property. It is the sole judge of the occasions and the reasons. But it must act in accordance with its own constitution. It must not arbitrarily choose A, B, and C to go to the wars. It must not take private property without just compensation. If it does these things, it subverts itself and plunges into chaos.

There is no peculiar sacredness about land titles as distinguished from other titles. If the annual tax on land is not paid, the title is subverted at once. So, too, if a special assessment, or a mere water rate, is not paid, the land is sold, and a new title delivered to the purchaser, and this happens even if the non-payment is the result of accident. Personal property is liable to seizure and sale in like manner, and this is right, because the state must have the means of existence. All persons have had notice that such are the conditions of civilized life, the alternative to which is the feudal system, or the worse condition that went before it.

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* Jeremy Bentham has given an analysis of the phrases in common use which are synonymous with law of nature, such as moral sense, common sense, law of reason, natural justice, natural equity, and fitness of things. "Common sense," he says, "means a sense of some kind or another which the author affirms is possessed by all mankind; the sense of those whose sense is not the same as his being struck out of the account as not worth taking. . . . If such a man," he adds, "happens to possess the advantages of style, his book may do a considerable deal of mischief before the nothingness of it is understood." ("Principles of Morals and Legislation," chap. ii.)

When we are told that the state could not divest itself of the right to resume possession of the land, we reply that it never has done so. It has only divested itself of the right to take it without just compensation. If any casuist puts himself back of the contract, and says it was wrong in the beginning and void *ab initio*, he has before him the immense task of turning the world over without a fulcrum; for the world, after an incalculable deal of shifting and balancing, has settled down to the belief that agreements made in writing should be kept.

Suppose we admit that there are two sides to the question, and that it is submitted to a jury from the moon. A holds that private property in land is a disadvantage to society, and should therefore be abolished without compensation to owners. B holds that it is an advantage to society, independently of constitutions and laws, and he shows in addition that a solemn agreement has been made that it shall not be abolished without compensation. Both advance such arguments as they may. A says (using the words of Mr. George in his speech at Brighton Beach, July 28, 1889):

"So monstrous is private ownership of land, so unjust is it—so ridiculous even is it, that a few men should be the owners of the element on which and from which a whole people must live—so clear is it that all men have by nature equal rights to the use of the land—that private property in land as we know it can only long continue where from the *force of habit* it is acquiesced in and never questioned. When it is thought about, when it is talked about, even when it is defended, it is doomed."

B replies that "force of habit" is another name for human experience, and that it has stronger presumptions in its favor than anybody's inner consciousness; that the usefulness of land resides in its cultivation, and that no man can show from inner consciousness that better, or as good, cultivation would result from the abolition of private ownership; and that, if worse cultivation should follow, the whole human race would be sufferers. Would not the men from the moon say: "Gentlemen, your arguments are somewhat confusing. We perceive that private ownership of land, like most of your institutions, has advantages and disadvantages; but there is one fact about which no confusion exists, and that is, that men ought to live up to their agreements. We accordingly give our verdict to B. And we do this with the more confidence because we believe that, when the disadvantages become clearly preponderant, you will find a way to overcome them without shocking the moral sense of distant observers."

IV.

Are the taxes on land in this country high enough or not? Is economic rent sufficient in amount to support government? We will consider these questions in their relation to agriculture.

The generally received idea of the single-tax party is that held by the physiocrats, that all wealth proceeds from agriculture, using that term to include all the products of the earth and the sea. This is a corollary of Mr. George's book, although I believe he has not explicitly affirmed it. I find an apt statement of it in the "Twentieth Century" of August 3d, viz.:

"Where all land is occupied, the annual rental value of the land of a nation is, theoretically, equivalent to its net annual production—that is, to the total production, less sustenance, interest, and replacement. This, through private land-ownership, is now all absorbed by a small number of individuals."*

It is needless to say that mere space, which is not applied to the growing or gathering or mining of anything, is not to be included in the wealth-producing parts of the earth's surface, according to the physiocratic conception—such as lots in towns and cities. If all wealth comes from the earth by means of agriculture, mining, hunting, and fishing, why should not they pay all the expenses of government and a fund besides for the general use? Would not those industries, after such deductions, still be as well off as the industries which have no share in the land? Is not the whole of a thing equal to all of its parts?

It is true that man draws his sustenance from the earth, and that the annual surplus which takes the form of capital, of whatever sort, there has its start. But where does agriculture begin and end? It is commonly supposed to begin with the making of roads, the clearing of land, and the destruction of beasts of prey. But, before land can be cleared, tools must be made. Axes, plows, spades, wagons, bows and arrows, gunpowder perhaps, must be manufactured. And where does it end? All production is undertaken to satisfy man's wants. These are not satisfied when a bale of cotton has been picked or a ton of wheat gathered into a barn. The wheat must be ground into flour, the flour must be baked into bread, the bread must be carried to the consumer. All these processes require labor in countless forms in the production of machinery, buildings, tools, packages, and transportation. The bale of cotton must be packed, carried to and fro, spun, woven, and again carried to and fro. So of every product of the earth, without exception. All industry and all commerce are concerned in changing the forms and places of the products of agriculture, forestry, mines, and fisheries.

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* I do not find any explanation of the word "theoretically," but I suppose that it was not used without a purpose. *Theoretically* a man who owns the only coal mine on the line of a railroad has a valuable monopoly, but it may turn out *practically* that he only has the privilege of working it on terms fixed by the railroad. I can point to cases of this kind.

John Stuart Mill ("Political Economy," Book I, Chapter II) asks why the grinding of corn should be considered a manufacturing employment, while the thrashing of it is agricultural. The only reason, he says, is that thrashing is usually done on the farm, while the grinding is done at a mill. Butter-making is counted an agricultural employment if it is done on the farm, but a manufacturing employment if it is done at a creamery. But it is the making of the butter, and not the place of making, that is the essential thing. Carry your imagination along all the ramifications of human industry to its farthest confines, and where can you find anything that is not analogous to the two related employments of the milk-maid and the butter-maker? Mr. Mill shows that the labor of astronomers, who help the sailor to find his way by the shortest paths over seas, carrying the farmer's products, is productive labor, and that whether it be called agricultural or not is of no importance to the sum total of the world's wealth. To draw a distinction, therefore, between agriculture and the manipulation and transportation of its products, as a source of wealth and taxes, is false reasoning.

Taxes must be apportioned among political units. The State of Connecticut is one such unit, and I choose this for present consideration because there has been a recent official examination of the profits of agriculture in that State, which enables us to see what economic rent amounts to in one of the most industrious and prosperous communities in the Union. It is embraced in the "Report of the Bureau of Labor Statistics for the year 1889." Mr. Hotchkiss, the commissioner, has sought to make out as good a case for agriculture as possible, to show that it is not in a distressed condition, or not necessarily so. What is the showing of economic rent in Connecticut?

Six hundred and ninety-three farms were visited. Three hundred and fourteen report average profits of $362.88. Three hundred and seventy-eight report an average loss of $268.59. One reports neither loss nor gain. In this calculation the farmer's family support was reckoned as part of the farm expenses, which Mr. Hotchkiss thinks is improper, since, in reckoning the gains of other trades, it is customary to deal only with the profits and losses of the business by itself. Making this correction, he finds that six hundred and fifty farms make an average profit of $551.36, and that forty-two sustain an average loss of $232.45. The average size of the farms reported on was one hundred and ten acres.

I can not agree with Mr. Hotchkiss that the family expenses ought to be deducted in estimating the profits, unless an allowance is made on the other side of the ledger for wages of the family. The children of farmers begin to work as early as ten or twelve years of age. Therefore, the first cited computation of the profits of farming in Connecticut is the nearer to the truth. The footings, as summarized by the commissioner, are as follows:

Total receipts from six hundred and ninety-three farms	$707,153
Total expenses, including family support	690,990
Total profit	$16,163

Among the farm expenses we find the gross sum of $37,526 set down to taxes and insurance, but there is no separation of the taxes from the insurance. It is apparent that if the gross sum of $16,163 had been added to the tax bills of these farmers, it would have taken not only the whole of the economic rent, but the profits on their capital besides. The statistics in hand lead me to believe that the single-tax theory is already in operation in rural Connecticut, "unbeknownst" to its advocates—that is, that economic rent is wholly taken by the tax-gatherer from agricultural land plus something from the returns of the farmers' capital invested in live stock, implements, and "distinguishable betterments," which the theory requires us to exclude from the list of taxables. Live stock, farming utensils, and wagons are shown in the report to be sixteen per cent of the farmer's capital, the real estate being eighty-four per cent. But the real estate includes buildings of every description, fences, drains, wells, and every kind of improvement.

If this is the true state of the case in one of the most densely populated States of the Union, where shall we look for the revenue that is to liberate all other industry from taxation and abolish poverty throughout the land? I know something about farming in the West, some years of my life having been spent on a farm in a then frontier State, where the conditions were substantially the same as those now prevailing in Dakota and Nebraska. I know that my step-father, the owner of the hundred and sixty acres under cultivation, had hard work to make ends meet in a very economical way, although he had a family of willing helpers. Tea and coffee were luxuries never seen in the household. Only one hired man was ever employed on the place, except in harvest-time. Thus the wages bill was kept down to a minimum.

The yearly tax bill took the whole of the economic rent, if not more, just as it now does in Connecticut. I remember that my step-father was glad to resign his advantages as a land-owner and accept a salary of five hundred dollars per year in a town, in lieu of his chances of being lifted into affluence by "the wedge thrust midway into the social structure," which Mr. Clarke pictures for us. I suspect that Mr. Clarke never worked on a frontier farm.

Between the extreme West and the extreme East I presume that instances of economic rent can be found in farming districts, but my observation teaches me that it is an insignificant affair in the total economy of the nation. When you have swept off all buildings and other distinguishable betterments, all live stock and other personal property, and when you have deducted fair wages, or if you please the family support of the farmer (generally of a very meager sort), the residuum of economic rent, I am very sure, will not be worth the trouble of confiscation.

If the single-tax theory prevails, what shall be done in those cases where economic rent is a minus quantity? According to the Connecticut report, three hundred and seventy-eight farms out of six hundred and ninety-three (fifty-four per cent) report no profits, but losses instead. Should they not be compensated in some way? Would it be fair for the state to take only the choice cuts of economic rent, and leave the bone and gristle? The least that it could do would be to abolish taxes on all land that yields no return to an industrious cultivator. Of course, there are good farmers and bad farmers. Some can make a living where others can not. But when the Government, in addition to all its other duties, takes up the task of separating all the distinguishable betterments of the country from all the land in the country, and rack-renting the land afterward, it will probably stop short of the task of discriminating between good farmers and poor ones. It would be obliged to stop taxing the non-profit-making farmers, if indeed it did not consider them entitled to some compensation out of the treasury for their labor. I do not see how otherwise the single tax would abolish the poverty of these three hundred and seventy-eight Connecticut farmers.

V.

The solidarity and interdependence of useful industry dispose of the complaint that all except land-owners are crippled and curtailed of their chance of earning a living. Says Mr. Clarke:

"A material thing is not rightfully the subject of absolute property if the appropriation of it by the exertion of one man's natural powers interferes with the equal right of other men to exert their natural powers.

"The appropriation of land does so interfere. To test the principle, it will be proper to take for illustration a community like New York or Massachusetts, whose laws maintain private property in land, and in which all the land has been fenced in or substantially so; for such communities are numerous, and, as population increases, will become more numerous. In such a community, obviously, a landless man can not do anything *individually*. He can not obtain for himself food or clothing or shelter or fire; he is dependent upon other men for such alms or for such employment as they are willing to give him."

When the fight against the English corn laws was in progress, it was urged by the protectionists that agriculture was the most meritorious of all employments, because it furnished food, without which man could not exist. I recall the apt reply of General Perronet Thompson, who said that, if you were to throw two men into the street, one without any products of agriculture and the other without any products of manufacture, there would not be much to choose between them. One of them would be hungry and the other naked. But the naked man would very soon be as hungry as the other, because he would have no tools to cultivate the land with, and if the temperature happened to be at zero the naked man would be frozen to death before the hungry man would be starved to death.

Mr. Clarke, I believe, makes his living by the practice of law, and, being a landless man, "can not do anything *individually*." He is "dependent upon other men for such alms or such employment as they are willing to give him." I, too, am in this plight. We two are therefore worse off theoretically than any of the Connecticut farmers whose pecuniary condition has been ascertained for us in the report of the Bureau of Labor Statistics. I say "theoretically," but I suppose that actually the case is somewhat different. If we are dependent on farmers for food, they are dependent on us for law and newspapers. They might get on after a fashion without law and without newspapers, perhaps, but they could not get on without houses, clothing, tools, wagons, railroads, ships, medicines, etc., the producers of which in turn have need of law and newspapers. The only man who can do anything "individually" is Robinson Crusoe. Neither of us would care to swap places with him.

There are other economic formulas in the essay before us as unsubstantial as this, but space serves to notice only one more. The merit or demerit of this belongs to Mr. George, Mr. Clarke having merely condensed what Mr. George has set forth at greater length. It relates to land held for speculative purposes, and the argument is, that the single tax will wipe out this speculative element and thus benefit society. Thus, it is said: "A very great body of land would become substantially free, and all the people of this country would stand, so far as abundance of natural opportunities are concerned, where their predecessors stood sixty or eighty years ago. . . . Furthermore, the annihilation of the speculative element of value is likely to have a particular beneficial effect in and near large cities, where now the density of population presents a great and terrible and threatening problem, before which, hitherto, all the wisest and most humane of men have stood gasping and helpless." Capitalists, it is contended, would hasten to erect comfortable houses for rent on vacant city and suburban lots "if, from the value of such lots, the speculative element were excluded. Houses would compete for men, instead of men cutting each other's throats, as now, in the competition for houses."

The first result of the application of the single-tax principle would be to discharge from taxation all unoccupied land in both city and country. The value, or rent-yielding quality, having been seized by the state, nobody would be so foolish as to pay taxes on property which neither now nor hereafter could bring him any return. All such holdings would be abandoned to the state, and this is exactly what is intended. Of course, the state would not tax its own property.

Then the state would say to capitalists, "You can build on this land on condition of paying ground-rent, and you will receive such interest on your capital invested in bricks and mortar as the law of competition will allow." But that is what capitalists can do now. By paying ground-rent they can build as much as they please. How is building to be expedited by changing the landlord? In fact, it would be retarded. At present the land-owner is spurred on to improvement by the hope of gaining a ground-rent and by the imposition of a yearly tax on his property, which he must pay whether it yields any return or not. Both these incentives would be wanting if the land were owned by the state.

How would it be with agricultural land held for speculative purposes? The state would say to the would-be farmer, "You can cultivate this land by paying the rent which neighboring land pays." But can not the farmer get the same land now on the same terms? Show me the owner of untilled agricultural land who refuses to allow his acres to be cultivated at a fair rental. I can show plenty of such land within one hundred miles of New York, and all over New England, which any cultivator can have the use of, without paying any rent at all, on condition of cultivating it. Surely the state would not offer land on more favorable terms. It would not let the land, rent free, and furnish the capital to cultivate it also. In short, no new opportunities for the cultivation of land would exist unless the state should offer better terms than present owners offer. But this the state could not do without sacrificing the fundamental principle of the single tax, which is that the occupier shall pay the full economic rent.

It is the testimony of all observers that, of two men of equal endowment cultivating land, the one being the owner and the other only a tenant, the owner makes the best use of the land, gets the largest crops, has the best cattle and the best orchard, and in all ways takes the best care of the property. The reason is very simple. It is because all the labor, skill, and economy bestowed upon the land enure to his own advantage. The net results belong to him, and this is sufficient reason for the employment of his best powers and for the practice of the utmost frugality. Capital arises from the exercise of industry and frugality. It is for the interest of the state that capital should be created. The system of land tenure which offers the greatest inducement to the creation of capital is the one most conducive to the public interest.

Again, the private ownership of land tends to stability in institutions. The ideas which gather about the word *home* are the most precious, both to the individual and to the community, that we are able to conceive of. A man will ordinarily undergo greater hardships, practice more self-denial, exercise more of the virtues which go to the upbuilding of the commonwealth, in order to secure a *home*, than to accomplish any other object. This is what his mind is first set on, and when he has gained it his efforts are equally enlisted to keep it. The single tax threatens to profoundly alter the meaning of this word as we understand it. It is not consistent with the idea of home that somebody should take it away from us by bidding at an auction. If it be said that no such auction would take place, but that the state would fix the tax at a rate previously ascertained as sufficient to take the economic rent, differing from the present tax only in amount, then we say that there is no means of ascertaining what the economic rent is. It would be possible to form an approximate estimate at the beginning by taking as a standard the rents paid by individuals for the use of land as a matter of bargain. But the standard would only serve for the first renting. What about the second? Land values change. It is the aim of the single tax to gather in the values that grow with the progress of society. A large part of Mr. George's argument is addressed to the coming time when all available land shall be appropriated. Renting by auction is the only process that will enable society to collect economic rent surely, equitably, progressively, and scientifically.

I have no apprehension that the single-tax theory will ever get beyond the argumentative stage in this country, or in any country where small ownership is the characteristic feature of agriculture. The land-owners have so many stakes in the country, and these are driven so firmly, and woven together so tightly, that no revolution can gain head which has for its aim to dispossess them of their homes and acres, or to unduly tax them.

No evidence exists showing or tending to show that agricultural land in the United States is capable of yielding any considerable amount of public revenue above what it now yields under the tax laws of the several States. Evidence corroborating that cited from the Connecticut Bureau of Labor Statistics has been supplied lately in a rapidly swelling stream, especially in the official publications of the Commissioners of Vermont and New Hampshire, where there are literally tens of thousands of acres of abandoned lands, which were once the homes of thrifty farmers, and which can now be had for no greater price than the present value of the improvements thereon. A remarkable letter from Judge Nott, of the United States Court of Claims, in the "Nation" of November 21, 1889, presents facts and reasoning thereon, which, whatever else may be said, show conclusively that in the fairest parts of agricultural New England there is nothing left for the single tax to sweep into the public treasury. In the presence of such facts, how idle is it for disputants to cull figures out of the census reports, as Mr. Shearman does in the "Forum" article previously cited, to show what was the value of farms in 1880, and what annual percentage they ought to yield—like measuring a man for clothes, at the distance of a mile, with a theodolite!

There is no subject more bedeviled with dogmatism than taxation. There is none in which dogmatism is less helpful. The more study one bestows upon it the less will he be inclined to lay down inflexible rules. While justice should be ever in the mind's eye, yet our conclusions must always be mainly experimental. Of all the dogmas on taxation the single tax on land is the most dogmatic, and the one least favored by experiment, so far as experiment has been made. In India the single tax has been in force from the earliest times, supplemented by other taxes only after economic rent had been exhausted. During the last half-century British India has been well governed, so that whatever blessings the single tax has in hiding ought there to have been disclosed. That it has not abolished poverty, or exhibited any tendency to do so, may be confidently affirmed.

There are some hundreds of professors of political economy in the colleges and universities of the civilized world. They are of various schools, including that of state socialism. Some are conservatives, others progressives, still others may be called radicals. They are men who have somehow got themselves recognized as fit to instruct others in the principles of the science which deals with the production and distribution of wealth, with land, labor, capital, interest, taxes, etc. Of course, they have all had their attention called to the single-tax doctrine. It has been "in the air" for ten years, and it is their business to know all the discoveries in their science, just as it is that of astronomers to know all the finds of new comets and satellites. If any one of them, either in Europe or America, has given his adhesion to the doctrine, I have not heard of him. All who have taken the trouble to give any opinion about it have spoken adversely. It can not be said that they are afraid to speak their real sentiments; most of them are free-traders, and nothing has been more unpopular than free trade, although that tide appears now to be turning. If the single tax contains the germ of truth, is it not a little remarkable that no member of the profession should have perceived and acknowledged it?

CHINESE SILK-LORE.[*]

By General TCHENG-KI-TONG,
SECRETARY OF THE CHINESE EMBASSY AT PARIS.

THE time of the hatching of silk-worms in China always corresponds with the first thunder of spring. As soon as the detonations are heard, a watch is set upon the eggs, which have been carefully made ready beforehand for the occasion; and the appearance of the larvæ may usually be counted on within five days, more or less.[†] Thunder at this season is the sign of that condition of electrical movement in the air which is produced artificially in Europe to hasten the hatching, by means of a shower of sparks.

For the protection of the mulberry-trees, the raising of *polyvoltines*, or worms that hatch several broods a year, is forbidden in many countries. But most caterpillars have only three moltings. Here I may remark that we define two periods in the moltings: the first, when the worms cease to take food, when we say that they lie down; and the second, when they lay aside their envelope, which we call their getting up. We also say, when we smother them with hot water, that they are taking a bath.

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[*] From an address given at the Orange Garden of the Tuileries, during the exhibition of Useful and Injurious Insects.

[†] The Emperor Yu, called the Great, ascended the throne 2205 B. C., and reigned twenty-seven years. He founded the second dynasty and completed the civilizing work of the Emperor Hoang-Ti, of whom he was a descendant. He divided each of the signs of the zodiac into two equal fractions of 15°. The farmers observe with the greatest attention the manner in which the several parts of this cycle follow one another, and prognosticate concerning meteorological phenomena from them. The observations made at Zi-ka-wei by Father Dechevrens do not lead us to suppose seriously that there was any foundation for this superstitious meteorology. The date of the entrance of the sun into each of these twenty-four divisions was indicated by that of the Chinese New Year. According to the calendar for 1888, as marked out by Bishop Perney's table, the 14th of February was the date for the opening of spring; February 29th, for rain; March 15th, for the hatching of silk-worms; March 31st, for real spring, etc. There is nothing absurd in the idea of a connection between the first electrical phenomena and the hatching of the worms; for the early electrical phenomena are usually associated with an atmospheric temperature favorable to such changes.

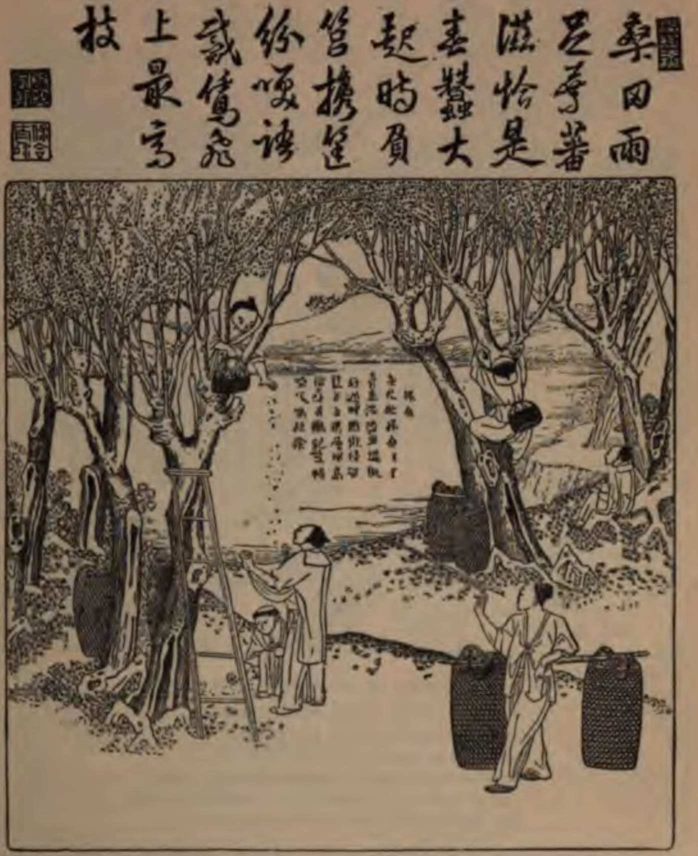
桑田雨足葉蕃滋恰是春蠶大起時負筥攜筐紛笑語戴鵀飛上最高枝

FIG. 1.—COLLECTING THE LEAVES.

Climbing the trees, the village boys
Fill the air with the songs of their age;
Each of the trees has its owner,
But every one respects his neighbor's.
The living leaf flies to-day into our basket,
And the zephyr is less quick than the hand that gathers it.

I am not acquainted with the significance of these terms, to lie down, get up, and take a bath; but I suppose that those who are charged with the duty of raising the worms wish to give them an orderly regimen.* The quality of our silk and the

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* The verse subjoined to our second illustration expresses the same thought as the remark of General Tcheng-Ki-Tong, that, to preserve the luster of the silk, the worms that

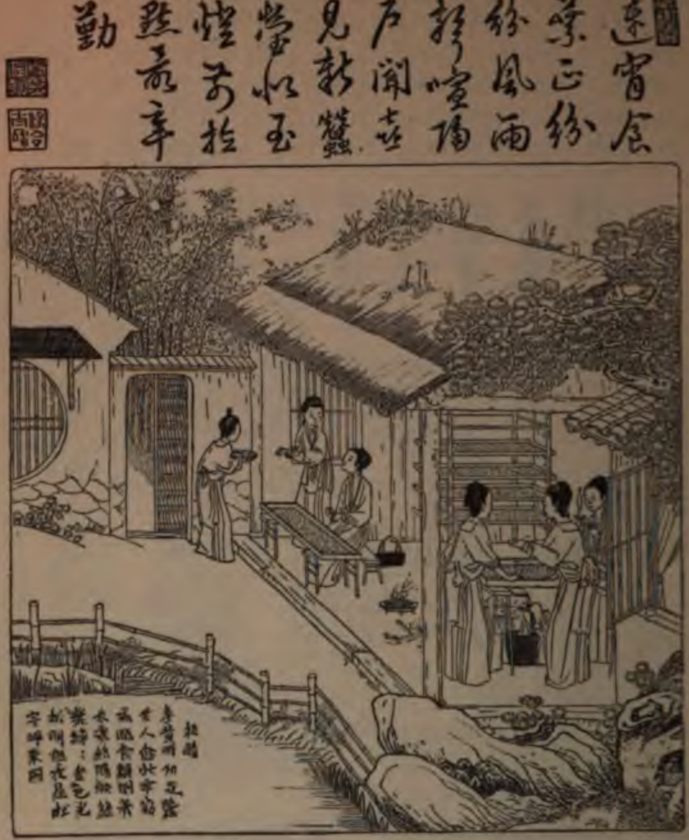

FIG. 2.—SEPARATION OF THE WORMS ABOUT TO SPIN.

A peculiar luster of the worm's belly
Is a sign that it is about to change,
And that its mouth will spin us its silk.
Madam busies herself in preparing its bed,
And lays it on the straw, that nothing may soil
The immaculate thread which itself fixes.

method of manufacturing are so well known that it is not necessary to relate them in detail in this short address; but I must remark upon one feature which, I believe, exists nowhere but

have ceased to perform their digestive functions must be carefully separated from those which continue eating. This duty, which requires experience, devolves upon the matrons, while the fabrication of the thread is assigned to the young women. But the separation is hardly as absolute as is assumed by the poet. It may be seen from our figures that the Chinese women, in preparing the silk fiber, use extremely rudimentary processes; but it must be remembered that manual labor is very cheap among the Celestials, and that, consequently, they have few inducements for economizing. The people, men and women, are assiduous workers, and make available instruments so rude that Westerners would find it very hard to use them at all. Only the culture of the domestic silk-worm is described in the treatise of the Emperor Kang-Hi, while the less precious though useful fiber of the wild worm is prepared in a quite different manner.

with us, and the discovery of which goes back to ancient times. I mean the music of silk. My countrymen, even before they had invented the art of working silk and making cloths of it, had discovered the secret of making it musical, and of drawing from it the sweetest and most tender sounds. From the time of the Emperor Fo-Hi (3000 B. C.) they made an instrument consisting of a board of soft, light, and dry wood, on which they stretched cords of silk twisted between the fingers. The board gradually assumed a definite shape and curvature, with measured dimensions. The cords were more artfully spun and composed of a determined number of fibers, and the number of them was fixed according to the character of the instrument desired. These cords, properly adjusted as to size and tension, were made to give

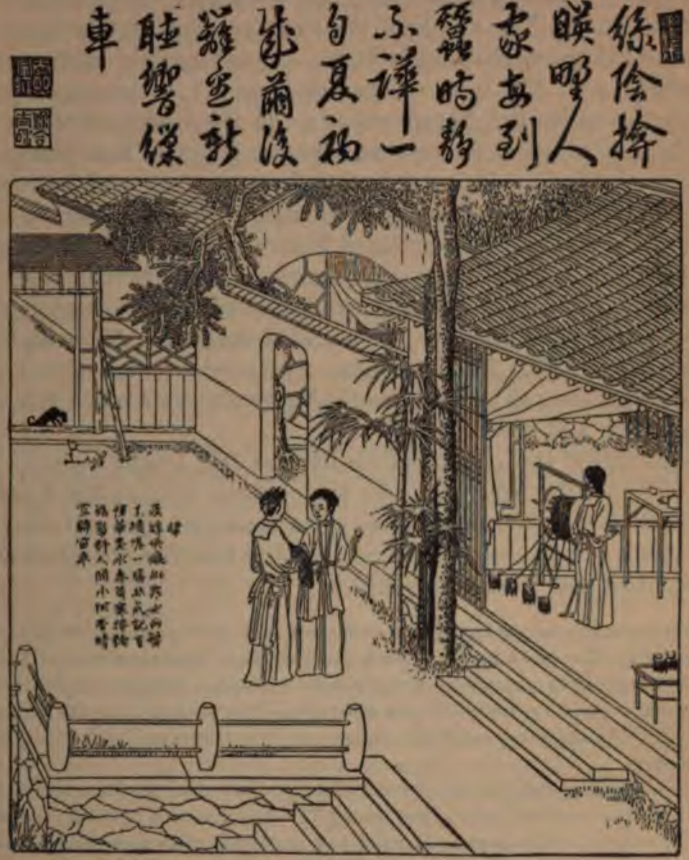

FIG. 3.—FABRICATION OF THE THREAD.

The steps in front lead to the clear water
In which, carried by a maiden, the skein
Is rinsed; on the right a turning wheel
Winds it, for ready hands to change it oft,
With care that it do not get knotted and tangled.

the tones of a regular stringed instrument. Such was, in short, the origin of our first musical instruments, the *kin* and the *ché*, which were both invented by the same person and at the same time, and both give the peculiar sound of silk.*

The construction of the instrument kin affords matter for an interesting study. It is made of toung-wood. The upper part is rounded, to represent the sky; the lower part is flat, and represents the earth. The abode of the dragon—that is, the upper part, from the bridge, eight inches down—represents the eight areas of the wind; and the nest of Foung-Hoang, or the same part at four inches in its height, represents the four seasons of the year. It is furnished with five cords, representing the five planets and the five elements. Its total length is seven feet and two inches, representing the universality of things. The inventor, by means of this instrument, first regulated his own heart and restrained his passions within just limits. He then labored to civilize men. He made them capable of obeying the laws; of doing acts worthy of reward; and of engaging in peaceful industry, by which they acquired the arts. Besides these five cords which give the five full tones, there are two others that give the half-tones and represent the sun and moon.

Concerning the construction of the ché, I will only mention that it had fifty and still has twenty-five cords; for I perceive that I am saying too much about the music of silk. It was, however, proper to give a full account of the kin, for it represents the first application of this music.†

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* The engravings accompanying this article are from photographs from an edition of the poem of the Emperor Kang-Hi, published at Shanghai. They show most evidently that the artist has depicted customs of a very remote antiquity. Men are employed only for operations that require strength, like the cultivation of the mulberry-tree, the collection of leaves, etc. The legends beneath the designs are free translations of the Chinese verses above them.

† The inventor of the kin and the ché was no other than the Emperor Fo-Hi, who reigned about two hundred years before Hoang-Ti. The invention of thread and of fire is attributed to him; and he taught men, who had previously eaten their meat raw, to cook it. The ché kept its fifty cords till the time of Hoang-Ti, when a young maiden played it before the emperor with such effect that he concluded that it was a dangerous instrument to hear, and too liable to excite the passions of the people. Instead of throwing himself at the feet of the siren, as a European monarch would have done, he in his wisdom decreed that the ché should in future have only twenty-five cords. Notwithstanding Hoang-Ti's edict, the number of cords has been varied several times. There have been sometimes twenty-seven, sometimes twenty-three, and sometimes only nineteen, but no one has ventured to go back to fifty; the changes having been instigated by considerations of the significance of numbers, to which the Chinese are much addicted. The ché has now twenty-five strings. Each string is held by a colored bridge. The first five are always blue; the next five red; the next yellow; the next white; and the last series black. The bridges are movable, and each one is adjusted according to considerations that we shall not enter into. There are four kinds of ché's, which are of different length, but of identical construction. They are played at court and in the Confucian temple. In the latter case four instruments

You know so well how our silk-worms are cultivated that I need not relate the details of the method. In principle there is not much difference between our method and yours; possibly yours is only a copy of ours, without pretending to possess any novel features. But our system goes back to twenty-seven hundred years before Christ. The queen of the Emperor Hoang-Ti at that time first conceived the idea of raising silk-worms and of making from their production garments with which to clothe the people over whom her august husband ruled.*

The invention had such a following that it is still spreading through the whole world on a growing scale. Notwithstanding we have the wool and fur of animals, silk still is and always will be an article of luxury that no one who has the means of getting it will do without.† We, who are always grateful to our benefactors, honor the inventor of the art of silk-culture with a real perpetual cult. Besides the temples which we have erected in all the corners of the empire, her Majesty the Empress goes every year at the hatching season, in person, with all her suite, and in great pomp, to the field of the mulberry, to sacrifice to the goddess who was the queen of the Emperor Hoang-Ti.‡ After the cere-

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are used, two of which are placed in the east and two in the west. Music was regarded by the ancient Chinese as an affair of state and religion, as a science revealed from heaven, a ray of the universal harmony emanating from divinity. Celestial forces and virtue were attributed to it. It was to them the science of sciences, the one by which all others were explained, to which they were related and from which they were descended. The modern Chinese have not abandoned their notions, although the sound of their music does not suggest them to Europeans.

* This celebrated woman, whose name was Louï Tseu, is adored as the goddess of silk. She was born, according to the Chinese historians, 2697 B. C., in the city of Si-Ling. Her husband was the first Chinese legislator, and reigned a hundred years—from 2737 B. C. to 2637 B. C.—and died at the age of one hundred and twenty-one years. One of his ministers composed the famous Chinese cycle; another constructed the celestial sphere; and a third regulated the notes of the gamut, with which he associated a metrical system. The Chinese refer the invention of wagons, bows, spun goods, and bells—in short, the origin of civilization—to that period.

† Mencius, the Chinese philosopher next in esteem after Confucius, said that after fifty years of age one could not keep warm without wearing silk clothing. It is likely that even before the time of Hoang-Ti the Chinese could make cloth of the silk of the wild worms, those that lived on the oak, for example. Another use of silk, which the author does not mention, was in the fabrication of the cords by means of which grand dignitaries received orders to strangle themselves. The messengers, who communicated the sentences to them, besides bearing the order written with the terrible vermilion, were usually instructed to proceed with the execution in case the victim had not courage to perform it himself. On the other hand, the emperor often expressed his satisfaction through gifts of balls of silk; whence originated the expression to "present the silk"; and this, being confounded with the sentence-bearing cords, has given rise to some curious mistakes.

‡ The calculation of the days for the performance of the traditional sacrifices by the Emperor is one of the principal duties of the astronomers of the observatory at Pekin. Since the ancient formulas no longer suffice for the determination of the dates, the astronomical bureau includes several Europeans, who are called assistant astronomers, and are

mony at the temple, her Majesty, followed by her ladies, goes int the field, and, surrounded by the farmers' wives, cooks some mul berry-leaves and lays them on a basket containing the newl hatched worms. The festival is closed with her winding a cocoo

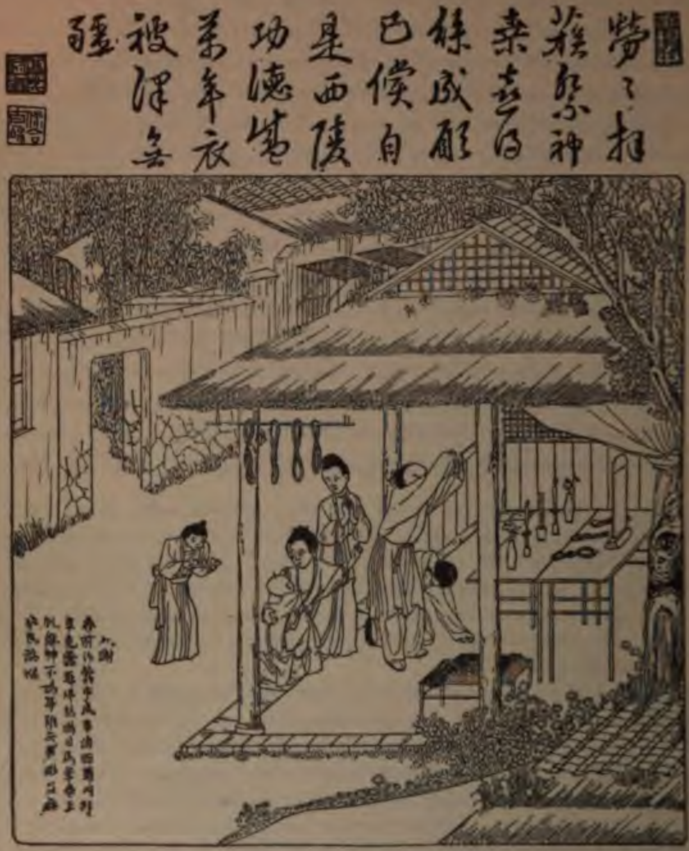

FIG. 4.—THANKS TO THE GODDESS OF SILK.

In Szechuen our ancestors in ancient times
Became masters of the precious worms;
So, when the snowy skeins we see,
Let us pay our vows, all, at Loui Tseu's feet,
Bending our heads before her shrine,
Offering her silk and the flowers of the land.

by way of setting an example, in the presence of the people, an distributing gifts to those persons who have been reported by th authorities of their villages as most worthy by reason of thei fidelity in attention to the care of the silk-worms.

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charged with making all the calculations. There are four full astronomers, two Chines and two Tartars, who appear in the religious solemnities. Under the reign of the Empero Kang-Hi the astronomers were Jesuits, and had a great influence at court. But they wer denounced at Rome by the Franciscans, as favoring idolatry. A suit ensued, which th Franciscans gained, and the Jesuits had to resign their long-held functions.

This ceremony, which is one of the most important of those her Majesty has to perform during the year, is a great incentive to the silk-raising population, who can not neglect their own work when they see their sovereign occupied in the same way. An old proverb says that "an idle farmer causes two persons to die of hunger, and a woman who will not weave will see ten dying of cold." The proverb illustrates the value of encouragement, and shows that silk-worm raising and weaving are duties of the women.—*Translated for the Popular Science Monthly from La Nature.*

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LETTERS ON THE LAND QUESTION.

[*Continued.*]

BY PROF. HUXLEY, HERBERT SPENCER, AUBERON HERBERT, FREDERICK GREENWOOD, AND DARCY WILSON.

PROF. HUXLEY'S SECOND LETTER.

To the Editor of "The Times":

SIR: After a careful perusal of Mr. Spencer's letter in "The Times" of to-day, I fear I can only reiterate my declaration that he "has not helped us much." So far as anything said in that letter goes, it remains an open question whether Mr. Spencer agrees, in principle, with Mr. Morley's "hecklers" or whether he does not. If any one maintains that private ownership in land was originally set up by force or by fraud, and consequently has no ethical foundation, I think, as matters stand, he has a right to cite Mr. Spencer's authority in favor of that position; and I, for one, very much regret that any person should possess that right. It seems to me lamentable that the "absolute political ethics" of to-day should have got so very little further than the point reached by Rousseau, the absolute political philosopher of one hundred and thirty years ago, who tells us that—

> Le premier qui ayant enclos un terrain s'avisa de dire *Ceci est à moi*, et trouva des gens assez simples pour le croire, fut le vrai fondateur de la société civile.[*]

Rousseau laments that there was no one to pull out the stakes and fill up the ditch of this primitive land-grabber; and to warn mankind that "the fruits of the earth are everybody's and the land nobody's."

These passages are cited from the famous "Discours sur l'Origine de l'Inégalité parmi les Hommes," published in 1754, in which I think will be found, implicitly or explicitly, all the propositions which Mr. Laidler discovers in "Social Statics" and attributes to Mr. Spencer.

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[*] [The first one who, having inclosed a field, took it into his head to say "This is mine," and found people simple enough to believe it, was the true founder of civil society.]

However, these are matters of opinion; and as Mr. Spencer, leaving the main issue aside, has put me on my defense, I hope I may say a word or two to show how very easy that process is; for, surely, nothing can be easier than to refuse to be charged with the consequences of opinions one does not hold. Mr. Spencer says that I "admit that all land-holders hold their land subject to the supreme ownership of the State"; and his remarkable inability to see that we disagree on the land question flows out of this assumption. But I admit nothing of the kind. If I declare that, under certain circumstances, the State has a right to shut me up and to make me work on the tread-mill, or to hang me, or to dispose of me and my property in any other way, it does not appear to me that "by implication" I admit that I hold my property, my liberty, and my life, "subject to the supreme ownership of the State." Surely the State is not my owner—I am not a serf—because I admit the right of the State to do these things! It is absolutely unintelligible to me that on such grounds as those alleged any one should try to force me to the conclusion that "the community, as supreme owner, with a still valid title, may resume possession if it thinks well."

And this leads me to another point. What historical ground is there for the assumption that the community (in the sense of "the State") ever had a "valid title" as universal land-owner? I am not ignorant that there have been and are such things as "village communities"; and if any one chooses to assert that communal ownership is the primitive form of land-holding, I am willing, for the sake of argument, to admit that such is the case. Let the further assumption that no agencies save force and fraud have broken up the communal organization (astonishing as it is) be accepted. Well, then, I see that a sort of an argument (though I think a very fallacious one) in favor of going back to ownership by village communities might be founded on these *data*. But what has that to do with State land-ownership, which has not the remotest resemblance to the communal system of antiquity?

Mr. Spencer addresses a sort of *argumentum ad hominem* to me. It is hardly chosen with so much prudence as might have been expected. Mr. Spencer assumes that, in the present state of physiological and medical science, the practitioner would be well advised who should treat his patients by deduction from physiological principles ("absolute physiological therapeutics" let us say) rather than by careful induction from the observed phenomena of disease and of the effects of medicines.

Well, all I can reply is, Heaven forbid that I should ever fall into that practitioner's hands; and if I thought any writings of mine could afford the smallest pretext for the amount of manslaughter of which that man would be guilty, I should be grieved indeed. Mr. Spencer could not have chosen a better illustration of the gulf fixed between his way of thinking and mine. Whenever physiology (including pathology), pharmacy, and hygiene are perfect sciences, I have no doubt that the practice of medicine will be deducible from the first principles of these sciences. That happy day has not arrived yet, and I fancy it is not likely to arrive for some time. But, until it comes, no practitioner who is sensible of the profound responsibility which attaches to his office, or, I may say, is sane, will dream of treating cholera or small-pox by deduction—from such mere physiological principles as are at present well established. And if this is so, what is to be said of the publicist, who, undertaking to preserve the health and heal the diseases of an organism vastly more complicated than the human body, seeks guidance, not from the safe, however limited, inductions based on careful observation and experience, but puts his faith in long chains of deduction from abstract ethical assumptions, hardly any link of which can be tested experimentally?

No doubt a great many foolish laws are passed. Also a great many foolish prescriptions are written; but the latter fact is not evidence in favor of "absolute physiological medicine," any more than the former testifies to the value of "absolute political ethics."

I am, sir, your obedient servant, T. H. HUXLEY.

EASTBOURNE, *November 15th.*

MR. HERBERT'S LETTER.

To the Editor of "The Times":

SIR: I more than suspect that my friend Mr. Greenwood can not have escaped a few moments' quiet amusement the other morning when he read his own letter in "The Times." Mr. Spencer, after many years, slowly and cautiously modifies a view formed earlier in life, and Mr. Greenwood thereupon addresses to the whole body of philosophers, to make use of his own words, "a heavy lesson." When, *currente calamo*, he took the philosophers under his charge for the purposes of instruction, did it never occur to him to ask himself how many oracles of his own it is the fate of the most careful editor—be he who he may—in the course of even one short year of political warfare to recall and silently replace by their opposites? The philosophers may have their faults, but I am afraid they are hardly to be convicted of them by any one who has, closely or remotely, independently or subserviently, followed the zigzags of political life.

And now as regards the question itself. There are some of us who have been watching for years with great pleasure the growing change in Mr. Spencer's views about land, and have only wished the change might go further. We have looked on "Social Statics" as one of the most splendid and helpful books ever written in the English language, and even the blot, as it seems to us, of land nationalization could not dim our enthusiasm for it; and now we —in saying "we," it is not an undivided "we," for I admit fully the divisions among individualists on this point—rejoice greatly to think that our leader has, at last, his doubts and hesitations whether land nationalization is a true article in the creed which he has taught us.

May I now add some reasons to those already given in "The Times" why land nationalization is both bad as philosophy and bad as expediency?

1. As philosophy. It is said that the land of a country belongs to the people as a whole. But if so, it is clearly the people, that is, the whole people without exception, to whom it belongs, and not a majority among them. Philosophy must be exact in her terms, and if she says it belongs to the people, she can not possibly mean two thirds or three fourths, or some other unstated quantity short of the whole. It may be, I can readily understand, a matter of practical convenience to politicians and other believers in power to treat a majority as society; but no amount of torture could wring from a Philosophy that knew what she was talking about the admission that the two things are equivalents. The deductions from this are plain. Property belonging to the whole people could never be used by any part of them, for the consent of the whole could not practically be got as regards any special use of it, seeing that every day, almost every hour, that whole is changing. We can, therefore, hardly accept a theory which lands us forthwith in an absurdity.

2. If the soil belongs to society in the abstract, and if, notwithstanding the urgent remonstrances of Philosophy, we decide to interpret the word "society" by the word "majority," why is it taken for granted that it belongs to that majority of the people who at any given moment happen to inhabit it? If the Chinese are overcrowded, or to come nearer home, if the Belgians are overcrowded, or if some part of the Russian people possesses a less attractive portion of the world to live in than our own, can they not claim with unanswerable logic that the doctrine of the majority has no merely local application, but must be treated in a far more comprehensive spirit? If Philosophy says the land of right belongs to the majority, it must also answer, "What majority?" and the nations that are now located on the least advantageous spots will not answer that question in quite the same way as the nations that enjoy the sunny side of the hedge.

3. It is claimed that the present owners may be dispossessed by force because some of them (a quantity that is diminishing

every day—see the yearly returns of land-sales) became possessed in old days of their land by force. But if an act of ancient force is sufficient cause to disinherit these holders of land, it must, I fear, also disinherit the whole nation, for we all came here by force. Celt, as far as we know, Anglo-Saxon, and Norman came by force, and the nation that is rather strangely asked to show its horror of past force by carrying out anew another wholesale act of force, is itself out of court for the very same offense as that under which it is proposed to condemn the land-owners.

4. All the articles of use and commerce—if we except those taken from water—are drawn in the marvelous laboratory of nature from or under the soil, or from the soil and air combined. Every tree, every crop of corn or roots, every fleece, contains in itself positively and actually so much of the soil where it was raised. Where, then, is the logic of declaring that certain particles—and these the very best—when taken from the soil may be private property, while the other particles—which are generally of lesser value—left lying in the field are, by some abstract right, the property of an unknown and unstated portion of the people—called a majority—who have never yet set eyes upon their property, and could not distinguish it if they did? My coat is now my private property; but years ago, before the grass grew which fed the sheep, the larger part was public property. What a marvelous transformation, and what inextricable confusion both of theory and of fact! How a thing which, as a matter of abstract right, once belonged to everybody, can rightly become my private property, I am utterly unable to understand. Perhaps Mr. George or Mr. Laidler could help me.

Then for the expediency. Is the race to deprive itself, for the sake of a theory that can not hold what is put into it better than a sieve can hold water, of the immense happiness and comfort that may come to thousands and thousands of families from the permanency of possession? If the land belongs to the majority, can there be this permanency? How can you let A and A's family retain forever the possession of the holding which he has industriously acquired, when B and C are waiting for their turn of what, without any industry or acquisitive virtue on their part, is declared to belong to them? That A is better fitted—naturally selected—to fill the holding, to use it happily and profitably for himself and for society, must count as nothing in face of the fact that B and C have taken the trouble to be born the owners of it. Then, too, comes in all the trouble and confusion about improvements, where property is split into this double ownership between the abstract state and the concrete holder. Improvements, we are told, can only realize their full value if there be a free sale and fixed rents. Do any persons in their sober senses imagine that the hungry, greedy, necessitous state of the politician will ever place itself on the same footing as it has placed the Irish landlord, upon whom the other day it so freely practiced its cheap philanthropy; that it will ever consent to fix its rents in perpetuity, or to abide by them if they were fixed? Then comes all the unutterable official management, the inspectorate, the armies of surveyors and clerks, the arrogant petty kinglets, the red tape, the annoying conditions, the unending correspondence on the subject of the new pump or the new road, the constant battle in Parliament as to new methods of land-tenure, new methods to allow A to replace B in quicker succession, new forms of land-taxation, universal upsetting of existing system, and universal establishment of the last land fancy of the half-baked theorist. Conceive for one moment the slough of despond into which you would plunge back a vigorous, self-helping nation that had once, however hesitatingly and half-heartedly, taken the first few steps along the road of individual initiative, experiment, and progress.

No, it is in another direction our efforts must be turned. Years and years ago, if our political parties were not—both of them—like wild beasts fighting, with no thought or sense, but for the mad struggle in which they lie locked together, biting and tearing with tooth and claw, they would have freed the land. They would have broken the lawyer's yoke that still curses our present generation and again and again prevents the ready sale, and they would have got rid of the heavy burdens of rate and tax that now fall on land and make it an undesirable possession for the poor man. Of all pieces of stupidity none is greater than taxing land just because the rich man at present holds the larger part of it. It is like all other pieces of class legislation, branded on its forehead with the fool's mark. You strike at your supposed enemy and wound yourself. Land must be made free in the only true sense—free from the clutch of the lawyer, free from the visits of the tax and rate collector, and it will then become the greatest source of happiness and comfort to our people. Once really freed, the industrious, vigorous poor will slowly wrest it from the rich man, paying, as has been seen in France, notwithstanding the heavy State burdens on land, a price that the rich man will not pay for its acquisition. Above all other forms of investment for the poor man, land is far away king. It is no pig in a poke for him. He knows it, he understands it in all its good and bad qualities better probably than any other living man; he can not be juggled out of it, when it is once bought, by the carelessness or fraud of directors; he can put all his spare time and spare labor into it. It is not, however, a question of the agricultural laborer alone, but also of the saving mechanic in town, who would look forward to the bee farm, or flower or fruit farm, on which he might end his days.

It is not only a question of the townsman; it is also a question of co-operative and trade-union societies, who also would learn to put their investments in land, perhaps producing for themselves, and offering in many cases opportunities of country life to their members who needed rest and change. Unless we persist in follies upon follies in the shape of legislative interferences; of expensive machinery to provide the people with land—machinery that will defeat its own object, for it must be paid for out of the rates, and will therefore increase the burdens on land; of forced agricultural agreements between landlord and tenant that tend to stereotype all farms in their present size; of State-hired allotments that, as in the case of our benighted dealings with Ireland, must tend to weaken the desire for ownership, the land of this country, now thrown upon the market at prices so far below its real value, industriously acquired and held in firm, unalterable fee-simple, will prove the greatest blessing to all classes of our working people. All that is wanted is to keep land free—free alike from Radical messing and Tory messing, and leave it what it naturally is—until spoiled by that blessed politician whose eternal finger finds its way into every pie—the sweetest reward for a man's labor and the most powerful incentive to undergo those labors. If you wish to develop all the virile virtues of our English country folk, and to place before them a worthy goal for their life-efforts, sweep away every obstruction and make it easy for them to gain their own home, held neither at the will of the land-owner nor of that worse modern creation—the changing majority inside Parliament.

I notice that Mr. Spencer still allows himself to think of that ogre, the land-owner, who might clear a district if so minded. That is true; but may I submit to him that it is equally true of a majority, and in one sense more true? A parliamentary majority which once considered itself lord and master of the soil might play any prank under high heaven that once occurred to it. It would be quite likely to turn a perpetuity into a thirty years' tenure, or a thirty years' tenure into a fifteen years' tenure, or to revolutionize every home in England in deference to the last notion that had got uppermost in its infallible head. Moreover, it should be seen that once the spirit of individualism begins to get hold of our people, the action of the landlord who cleared the estate would serve to redouble the efforts of the people to become absolute owners of their property. Unconsciously he would be the instrument of a good greater than the harm he had caused. We have not yet sufficiently profited by Mr. Spencer's teaching to recognize the enormous stimulus for good which there is in every form of evil when once we are fairly on the track of fighting it with the true self-helpful remedies. What delays and impedes the human race is far less the evil that abounds than the false remedies which we apply to cure it. It is hardly too much to say that human improvement is due to the evils and difficulties of life overcome in the right way.

One last word. Men doubt about "absolute political ethics." Yet they do not doubt about absolute principles in physics, in chemistry, in biology, in psychology, or even in the ethics of private life. Does it never strike them that it is a mightily strange thing—requiring, I think, some explanation on their part to which they do not often condescend—that we should live in this world almost surrounded by order, or fixed law, on every side of us, and yet in one special department of it—that of political action—this order should suddenly be replaced by disorder and uncertainty? Does it never occur to them that this strange inexplicable contradiction may be not in nature, but possibly only in their own minds? Does it never occur to Prof. Huxley, who is not an admirer, I suspect, of our party warfares, that the danger of modern civilization, the unscrupulousness, the corruption, the cowardice, the shiftiness, the untrue motives that flourish in public life have their stronghold in this belief that politics are an Alsatia, where alone in the wide universe the writ of the Great Power does not run? Does he not see that as long as politics are held to be outside moral law and scientific statement so long we shall be at the mercy of all those who for their own purpose try to persuade the people to believe the ignoble creed that whatever they desire is right, that the measure of their wants is the measure of the just and true? Some day, when possibly men may have forgotten "the heavy lesson" my friend Mr. Greenwood addresses to the philosophers, they may, warned by the great social dangers pressing upon them, turn round and see the full meaning of Mr. Spencer's work, and understand that he alone has pointed to them the path that leads out of the wilderness.

May I say that I am always glad to send some of our individualist tracts to any person who writes to me?

I am, very faithfully, AUBERON HERBERT.

OLD-HOUSE, RINGWOOD, *November 14th.*

MR. GREENWOOD'S SECOND LETTER.

To the Editor of "The Times":

SIR: If the question is whether Mr. Herbert Spencer is right in endeavoring to purify the conduct of public affairs and discharge it of error by establishing a system of "absolute political ethics, or that which ought to be," I submit that he need not have said so much as he has lately said in your columns. Who doubts that he is right? Who doubts that he is wisely and nobly employed when his business is to discover the bases of true political morality, and to exhort mankind never to lose sight of them, whatever may be the stress of expediency or compulsion in the world as we find it? But is that the question that was raised on the conversation between Mr. Laidler and Mr. Morley at Newcastle? Not at all. By that conversation we saw in a remarkably plain way that large numbers of the most intelligent and powerful representatives of labor in this country had derived from Mr. Spencer's teaching these conclusions: That private property in land is a public wrong based on force and fraud, and that to right one wrong it is sometimes necessary to do another. This they took to be a lesson in practical politics; and what it points to, in practice, is perfectly clear. Resume possession of the stolen land, if you please, for as private property it still is, and under its present ownership it must ever remain, a wrong to the community. For the rest, though compensation must be made for whatever is in the land which was not in it when it was stolen, yet to right one wrong it is sometimes necessary to do another. That is the point for attention as the matter stands at present. For though Mr. Spencer tells the people, as he could and should have told them from the first, that just compensation would entail a disastrous outlay, infallibly to become more disastrous through inferior management of the land by public officials, what of that if, to right one wrong, it is sometimes necessary to do another? What of just compensation, if it makes a standing crime against the community completely irremediable, and if the people are at liberty to decide whether this is not a case where to right one wrong it is necessary to do another? The point has been actually considered by labor societies and the leaders of the new Socialist movement all over the country, and it seems quite clear that the Newcastle Labor Electoral Association, for one, has come to the conclusion that, morally, there need not be much punctilio about compensation.

But perhaps Mr. Spencer has never said that to right one wrong it is sometimes necessary to do another. In one of his letters to "The Times" he wrote that he could not be positive whether he had or not; which seems to imply that he would not be surprised to learn that at one time or another he had included this doctrine in his teaching of absolute political ethics. Be that as it may, however, he could have told us when he was challenged on the subject whether this is his teaching now or not. He has written three letters; we remain in the dark on the most important point of all, and at the close of an argument entirely occupied with a defense of propagating "absolute political ethics" Mr. Spencer announces his determination to go no further with the controversy. Meanwhile here is Mr. Laidler in his old position, and here left. To be sure, it seems difficult to include the dogma he rests upon in any system of absolute political ethics; and if Mr.

Spencer had not said that he could not be sure that he had never preached it, we might conclude without further inquiry that the doctrine had never been his. As matters stand it would be an extremely good thing if he could assert that he does not hold it now, anyway. That done, his counsel against the nationalization of the land as a fatally bad bargain (since it must be carried out on just compensation principles if at all) would have full effect. It is to be hoped that Mr. Laidler's questions in "The Times" of to-day will be answered, and they will be if Mr. Spencer does not turn his back on doubting disciples who cry to him.

Your obedient servant, FREDERICK GREENWOOD.

November 15th.

MR. WILSON'S LETTER.

To the Editor of "The Times":

SIR: Mr. Laidler has given us a digest of the ninth chapter of Mr. Herbert Spencer's "Social Statics," and asks triumphantly, "Does it not constitute an unanswerable argument in favor of the nationalization of the land?" Mr. Spencer has modified the views expressed in that work, but, as Mr. Laidler now elects to stand or fall by them, it may perhaps be worth while to inquire how far they support his proposals.

The nationalization of the land, as defined by Mr. Laidler in his interview with Mr. Morley, means that the land, but not the houses, of this country should, on the death of the present owners, revert to the nation or State without any payment therefor.

In the "Social Statics" it is argued that each one of the race of beings born into the world has equal rights to the use of this world, and that no one or part of such race of beings may use the earth in such a way as to prevent the rest from similarly using it. From this it follows that land can not justly become the property of individuals; but it also follows that no given portion of the globe can justly become the property of any individual nation, for that would be to deprive the rest of "mankind at large," the rest of "the human race," of their equal rights. It is true that Mr. Spencer in one place says that under his system, instead of leasing his acres from an isolated proprietor, the farmer would lease them from the "nation." But this can only be reconciled with the rest of the chapter if the nation is understood to be acting as the "agent or deputy agent" of the community at large. According, then, to the argument in the "Social Statics," the land of this country should belong, not to individuals nor to the State, but to the human race.

Mr. Spencer is also in favor of giving existing owners compensation. On this he says that—

> Great difficulties must attend the resumption by mankind at large of their rights to the soil. Had we to deal with the parties who originally robbed the

human race, we might make short work of the matter. But, unfortunately, most of our present land-owners are men who have, either by their own acts or by the acts of their ancestors, given for their estates equivalents of honestly earned wealth, believing that they were investing their savings in a legitimate manner. To justly estimate and liquidate the claims of such is one of the most intricate problems society will one day have to solve.

What Mr. Spencer advocates is, in short, that the land should revert (*a*) to the human race, (*b*) after payment of compensation. And it seems to be generally admitted that the compensation would amount in the shape of interest on purchase-money to a greater sum than is now paid in rent.

So far, Mr. Laidler and Mr. Spencer do not seem to have much in common. The one point on which they do agree is that the existing titles to land are not legitimate, because they are founded on "force or fraud." Let us apply this view to England. When this country was conquered by the Normans the land fell into the hands of the sovereign, or, in other words, the State. It was then granted out in part to Normans, and in part to existing owners. How can it be said that the grantees obtained their land by force or fraud? They obtained it by grant from the State. The title of the State which made the grants did, no doubt, depend on conquest or force. But if this fact is to invalidate the title of existing owners, it must, *a fortiori*, utterly destroy the title of the State to resume its possession to-day.

The schemes, then, for dealing with the land appear to be three in number: (1) Mr. Laidler's, that the land should revert to the State without compensation; (2) that it should so revert with compensation; (3) Mr. Spencer's, that it should revert to the human race with compensation. Of these, the first has been truly described as robbery, and the second as folly. The third seems to be a philosopher's dream.

I have the honor to be your obedient servant,

DARCY WILSON.

BOODLE'S, ST. JAMES'S STREET, *November 16th.*

MR. SPENCER'S THIRD LETTER.

To the Editor of "The Times":

SIR: I suppose I may make a denial without continuing a controversy; and, unless I make it, a grave charge against me will remain unrebutted.

Over and over again Mr. Greenwood refers to the statement that I have said that "to right one wrong it is sometimes necessary to do another," and apparently wishes to force it upon me notwithstanding what I supposed was a sufficient repudiation. Being unable to recall all the contents of some ten thousand pages, written during forty years, I said as much as it seemed possible to say with reason; for it has sometimes happened that opinions have been quoted with approval as mine which I had quite forgotten were mine. I therefore wrote, "My belief is that I have not said this in any connection." That is, I am absolutely unconscious of ever having written it, and do not believe I ever did write it. I do not see what more was required. Mr. Greenwood urges that I have not repudiated it even now. It never occurred to me that, after what I said, this was needful. But, as he thinks otherwise, I very willingly repudiate it, both for the past and the present.

Even did I wish to continue my discussion with Prof. Huxley, it would be ended by his letter. From it I learn that the principles of physiology—as at present known—are of no use whatever for guidance in practice; and my argument, therefore, collapses.

I am, etc., HERBERT SPENCER.

ATHENÆUM CLUB, *November 18th.*

PROF. HUXLEY'S THIRD LETTER.

To the Editor of "The Times":

SIR: It seems to me to be a pity that the discussion which has been carried on in your columns should come to an end before Mr. Laidler's able letter of the 15th instant has been considered on its merits. I conceive it to be a matter of vital importance to the whole nation that the representatives of labor should be under no misapprehension with respect to the grounds of any action they may think fit to take. And as, all my life, I have done my best to bring sound knowledge within reach of the working classes, I trust that they will do me the justice to believe that I am actuated by no other motive now.

Let me say, at the outset, that I have expressed no opinion, and that I do not intend to express any opinion, as to whether State ownership of land is desirable or not. If it can be proved by arguments, having some foundation in practical experience, that the abolition of several ownership in land and the substitution for it of State ownership is essential to the welfare of the people, no one would feel more bound to give practical effect to that demonstration than I.

In Mr. Laidler's letter, however, such arguments are not employed. On the contrary, he adopts the method of Rousseau and his followers, which consists in making certain assumptions about matters of ethics in the first place, and certain assumptions about matters of history in the second place, and then drawing the obvious conclusion that the assumed facts are in sad disaccordance with the assumed ethical rules. It is a delightfully easy method, and saves all the trouble of going deeply and thoroughly into the foundations of ethics and the truth of history which the scientific plodders give themselves.

Now, I do not propose to discuss the ethical assumptions set forth by Mr. Laidler. Let it be granted, for the moment, that "equity does not permit property in land," and that "men are equally entitled to the use of the earth." Well, starting from those axioms, I fail to see by what logical process one gets at State ownership. If "equity does not permit property in land," how does it contrive to permit State ownership? The State is only a name for a body of men; and, if "all men are equally entitled to the use of the earth," why have Englishmen any more right of property in the soil of England than Frenchmen or Germans, or, for the matter of that, the natives of Timbuctoo, have?

Thus it is the logical consequence of the doctrine of the Rousseauites that nations are as much usurpers as individuals, and that there can be no valid title to land until the whole surface of the habitable globe has been thrown into hotchpot, and that share which every man may enjoy the use of, without damage to his neighbors, determined by a cosmopolitan *plébiscite*.

Thus, if we are to appeal to logical consequences, those of the principles adopted by Mr. Laidler's authorities are just as startling as those of the principles of the advocates of the "absolute" rights of private property. And I would put it to Mr. Laidler, as a man conversant with the practical side of life, whether this does not suggest to his mind that modes of reasoning which lead to obvious absurdities must be fundamentally vicious?

Now let us turn to the historical assumptions of Mr. Laidler's authorities. They affirm that several ownership of land originated in force and fraud—whereby the nation, in whom the ownership was previously vested, was robbed of its rights. And from these *data* they argue that the nation is justified in "resuming" its "rights to the soil."

Now, this is an assertion as to a matter of historical fact which can be tested. In the course of the last thirty years a vast amount of evidence has been obtained respecting the manner in which land is and has been held by people in an early stage of civilization all over the world. And resting on this foundation of laboriously ascertained truth, is the conclusion that the tenure of land by communities is that which most extensively prevailed in remote antiquity. What this exactly means will perhaps be best made plain by the supposition that the land in every parish in England was owned, not by one or more private individuals, but by the males of one or more resident families, forming a corporation in which the ownership vested. The land of the community, in fact, resembled an entailed estate, which should be inherited by all the males of a family collectively, they being forbidden to alienate any portion of it.

This "joint family" or "village community" system, therefore, so far from denying the right of several property in land, is founded upon that right. Assuredly, our ancestors did not trouble themselves much about the philosophical foundations of property. But I am well assured that if any one had tried to persuade a village community that all mankind had as much right as they to their land, that missionary of "absolute political ethics" would have been short-lived.

It may be said that I have been talking about the archaic existence of "several" property in land, while the question is about "personal" property. But is that so? Are the land reformers going to exempt corporate several ownerships in land, when they abolish personal ownerships? If so will they explain why corporate several ownership is less an infringement of the rights of mankind in general than personal ownership? But if corporate several ownership is not "permitted by equity" any more than personal property—if the archaic communities had no more valid title than the squires who have succeeded them—whence comes the evidence that those rights of "mankind at large" to the use of the soil, which we are told they are to "resume," ever existed?

Let us, then, clear our minds of all the cant of "history after the manner of Rousseau." Genuine history shows that, as far back as the constitution of settled society can be safely traced, several property in land was recognized and acted upon. It also affords much ground for the belief that individual property was recognized in the case of the clearer of forest land; that either individual or family several property was recognized in the case of the plot of land in which the house was situated; and that, in bringing about the change from collective to individual severalty, industrialism has been just as important a factor as militarism. State ownership may be right or wrong, but those who suppose it to be a resumption by the people of a right they ever exercised, or even claimed, are at variance with the plainest teachings of history.

I am, sir, your obedient servant, T. H. Huxley.

Eastbourne, *November 19th.*

P. S.—Mr. Spencer, in the letter which you publish to-day, says that he learns from me that "the principles of physiology, as at present known, are of no use whatever for guidance in practice." I think that Mr. Spencer must have achieved this feat of learning by his favorite *a priori* method, for nothing of the kind is discoverable by mere observation and deduction in what I have said. No phrase of mine is inconsistent with my belief that the principles of physiology, like those of ethics, are of great use, so long as they are applied with that caution and discretion which are to be gained only by practical experience in medicine or in affairs. If Mr. Spencer were acquainted with the history of medicine or with the present relations of physiology and therapeutics, he would have been unable to learn from me that which it would have been ridiculous in any one to teach.

MR. GREENWOOD'S THIRD LETTER.

To the Editor of "The Times":

SIR: Without meaning to do so—I am quite sure of that—Mr. Auberon Herbert has placed me in a false light. It might be supposed, from a letter in which he deals with much more important things, that I had reproached Mr. Herbert Spencer with changing his opinions, which would be great presumption. That, however, I have not done; and, indeed, there is no reproach in changed opinions when they are not fundamental, and when the one judgment and the other are not based on the same unaltered *data*. My complaint was against the publication of imperfect theories of social reform "unaccompanied by a clear statement of whatever reasons are fatal to their application in this work-a-day world," the point being that certain doctrines of Mr. Spencer's, acknowledgedly ill-considered and so unaccompanied, had gravely misled large numbers of men eager for social revolution. That is a very different thing from complaining of reasonably changed opinion. Mr. Auberon Herbert seems also to make out that, on the ground of reasonably changed opinion alone, I presume to impose "a heavy lesson" on political philosophers. It would have been arrogant indeed if I had so described my interference, as Mr. Auberon Herbert suggests. But here he does me wrong altogether. My account of the matter was that the conversation between Mr. Morley and Mr. Laidler, together with Mr. Spencer's letter on that conversation, conveyed "a heavy lesson" to political philosophers. That is what did it. I had nothing to do with a lesson ready made.

The controversy has been extremely useful—thanks to your liberal publication of it—and will do a world of good all round, especially after Mr. Spencer's welcome letter of to-day.

Your obedient servant, F. GREENWOOD.

November 19th.

PROF. CROOKES expresses the opinion, pertinent to his researches on the rare earths, that while, besides compounds, we have hitherto recognized merely ultimate atoms or the aggregations of such atoms into simple molecules, it is becoming more and more probable that between the atom and the compound there is a gradation of molecules of different ranks, which may pass for elementary bodies. For these bodies he offers the provisional name of "meta-elements." Their true character should be the subject of future unbiased research.

EXERCISE FOR CHEST DEVELOPMENT.*

By FERNAND LAGRANGE, M. D.

HOW is it that the lungs can increase in size through athletic exercise? By a mechanism well known in physiology, by the filling out of certain air-cells ordinarily inactive, which only come into play during forced inspiration. The expansion of the pulmonary vesicles is complete in proportion to the quantity of air introduced. The atmospheric air drawn into the lungs by a very powerful inspiration seeks out the most obscure corners, and inflates the air-cells of certain regions which ordinarily have no part in the respiratory function.

A definite increase in the volume of the lungs is the consequence of frequent repetition of this supplemental respiration. The air-cells which are as a rule inactive, and which are reserved for cases of excessive respiratory strain, arise from their inaction; their walls, which are usually collapsed, and even stuck together, separate and give entrance to the air which can not find room in the confined space sufficient for ordinary breathing.

If the forced inspirations are often repeated, the air-cells, the action of which has thus been accidentally solicited, come in the end to associate regularly in the ordinary respiratory movements. They are then very quickly modified in the sense most favorable for efficient working, according to the law we have so often pointed out, of the adaptation of organs to the functions they perform.

Thus, forced respirations result in a modification of the structure of certain regions of the lung, and in making them work better. Under the influence of unusual exercise the vesicles increase in size and contain more air. More blood is also supplied to them. Their capillary network becomes richer, and their nutrition more active. Thus in the end they take up more room.

It is in this manner that the regular working of a great number of air-cells, ordinarily inactive, can rapidly increase the size of the lungs.

If we follow out the modifications produced by forced respirations, we see that the lungs thrust outward the thoracic walls to make more room for themselves. During inspiration the ribs, by rising, favor the inflation of the lungs; but in this case it is the lungs which, having increased in size, thrust the ribs upward and keep them raised even in the condition of repose. Hence an increase in the circumference, and a vaulted conformation of the thorax.

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* From advance sheets of the author's work on "Physiology of Bodily Exercise," in the "International Scientific Series," to be issued shortly by D. Appleton & Co.

It is then *from within outward* that the force capable of expanding the chest acts, and it is in reality to the lungs and not to the muscles that the chief share in the changes in form and size of the chest belong. The most powerful inspiratory muscles can not raise the ribs, unless the lungs participate in the movement of expansion, and, on the other hand, the lungs can raise the ribs without the aid of the muscles, for the chests of emphysematous patients remain vaulted in spite of their efforts to lower the ribs and complete the expiratory movement.

If we sum up the facts we have just enunciated, we shall be driven to the conclusion that, in order to raise the ribs and get rid of the vicious conformation of flat chest, we must not seek to act directly on the thoracic muscles, but to produce as extensive respiratory movements as possible.

There are two methods of amplifying respiration: one consists in voluntarily expanding the thorax in all directions. This method is in the domain of "chamber gymnastics"; it has been much extolled, and it may give good results. The other method comes more directly into the field of our studies. It consists in increasing by exercise the amplitude of the respiratory movements.

The problem has now become clear and definite. We need, in order to develop the chest, to know what exercises are most fitted to produce a series of very extensive respiratory movements. Now, the amplitude of respiration, as well as its frequency, is in direct ratio to the intensity of the respiratory need, and we know that the intensity of this need depends on the quantity of mechanical work performed in a given time.

The exercises which cause an *accumulation* of work are, then, those most fitted for increasing the size of the thorax, and for demanding increased work from the lungs. And we know that this accumulation of work occurs especially in exercises of strength and speed.

Thus the mechanism of exercise, its performance by the aid of these muscles or of those, are of secondary importance in producing the result of which we are speaking. It matters little by what process the muscular force is expended, provided that there is great expenditure in a short period of time. It is indifferent whether the movements are very slow, each of them representing a great number of kilogrammetres, or whether they are extremely rapid, each movement representing but a moderate effort. It is merely necessary that the sum of work represented by these movements, whether few or many, should be considerable in a short time.

Now, the quantity of work which a given muscular group can perform in a given time is subordinated to the strength of this group. There are muscular groups which are too weak to expend much force in a short time. One arm may use its whole strength without its work representing, in the unit of time, a great number of kilogrammetres. So, whatever form the exercise takes, if the arm alone is working, we shall not find that the breathing is much quickened. The exercise may induce local fatigue before the intensity of the respiratory need has increased. It may even happen that the work of both arms together does not, after a given time, amount to enough to demand more ample respirations.

In general, the exercises which are performed with the legs represent more work than those which are performed with the arms. The muscles of the upper limbs could not support, without extreme fatigue, an expenditure of force which will cause no effort to the lower limbs. It is not tiring to any one to walk five hundred metres in five minutes: what gymnast could traverse the same distance in the same time hanging by his hands from a stretched rope? The total mechanical work would be, however, the same—displacing the same weight through the same horizontal distance.

We must not, then, trust to the muscles of the arms to expand the chest. Muscular exercise can only lead to the development of the thorax in an indirect manner, and in no way by a direct effect comparable to the increase in size of a muscle which works. The muscle which contracts often becomes larger because its nutrition is more active. But the chest only expands when the surcharge of the blood with carbonic acid creates a need of a greater quantity of oxygen for hæmatosis.

It is to the more active respiratory need, to the "thirst for air," that the instinctive movement by which the ribs are more energetically raised is due, in order to draw into the lungs a greater quantity of air.

The thirst for air, carried too far, produces breathlessness, which is nothing else than a powerless struggle of the system seeking in vain to satisfy a need. When breathlessness is very moderate, it causes very ample respiratory movements; but when it is excessive, the breathing becomes very shallow as well as very rapid. So that exercise has no longer any effect in expanding the chest when breathlessness reaches an extreme degree.

To sum up, the most profitable way of dilating the lungs, developing the thorax, and expanding the chest, consists in the performance of exercises capable of increasing the respiratory need, without pushing them so as to produce an extreme degree of breathlessness.

If we pass from physiological explanation to observation of facts, we see that practice gives a striking confirmation of theory.

Exercises of strength lead rapidly to an increase in the size of the thorax. It is the same with exercises of speed when they need very energetic movements. No exercise develops the chest as rapidly as does running, unless it be wrestling.

Mountaineers all have large chests, and the Indians who live on the high plateaus of the Cordillera in the Andes have been noted for the extraordinary size of their chests. This great development in mountaineers is due to two causes which act in the same direction: frequent ascent of steep inclines, and constant residence at great heights at which the air is rarefied. The climbing of these slopes needs a great quantity of work, which causes increase of the respiratory need; respiration in a rarefied atmosphere obliges a man to take deeper breaths in order to supplement, by the quantity of air breathed, the insufficiency of its vivifying properties.

Singers, with no other exercise but singing, acquire great respiratory power and a remarkable increase in the dimensions of their chests.

Numerous observations prove that it is enough voluntarily to take a certain number of deep breaths every day, to produce, in a short time, an increase in the circumference of the chest which may amount to two or three centimetres.

If we wish to gain the same result from muscular exercise, we must choose a form of work which will increase the intensity of the respiratory effort—that is, an exercise which brings powerful muscular masses into action. We shall thus perform a great quantity of work in a short time without producing fatigue. Now the legs, which possess three times as much muscle as the arms, can perform thrice the quantity of work before being fatigued. The lower limbs are, then, more capable than the arms of awakening the respiratory need, which is proportional to the expenditure of force.

Thus it is an error to demand from gymnastic exercises practiced with appliances, exercises of *suspension* or *support*, any development of the chest. The trapeze, the rings, the parallel bars, quicken respiration much less than running. These exercises cause an increase in the size of the muscles, and even of the bones of the regions which work, but they cause very little increase in the dimensions of the thorax.

Men who do much work with their arms have often a conformation which is very imposing at the first glance. They have sometimes broad shoulders; but if the arms have done the work alone, without the assistance of the muscles of the trunk, we easily see that the apparently large size of the thorax is due to an excessive development of the muscles about the shoulder-joint, and not to raising of the ribs.

Thus we are on the wrong road when we look for too ingenious means for developing the chest; this result, precious above all, can be obtained without any complicated appliances, without any difficult process; and if we had to formulate concise advice on this subject we should say:

When a young person has a narrow and flat chest, recommend running if he be a boy, or skipping if a girl.

CANADIAN ASBESTUS: ITS OCCURRENCE AND USES.

By J. T. DONALD, M. A.,

PROFESSOR OF CHEMISTRY, MEDICAL FACULTY, BISHOP'S COLLEGE, MONTREAL.

ASBESTUS is a singular mineral, whose characteristics are well indicated in the various names by which it is known. The French Canadian miners call it *pierre à coton*—i. e., cotton-stone. The Germans speak of it as *Steinflachs*, stone-flax; and *amianto*, the Italian name, indicates that which is undefiled, in allusion to the fact that it may be cleansed by fire. *Asbestus*, the name by which it is generally known, is a Greek word, signifying endless, ceaseless, and points to its fire-resisting properties.

Asbestus is, then, a mineral occurring in a fibrous form, the fibers being so fine and flexible that they may be spun and woven as cotton and flax are; and, moreover, the fabric so obtained is capable of resisting a very high temperature. Some varieties are said to have resisted a temperature of 5,000° Fahr. It must be noted, however, that although this mineral is infusible, except at extremely high temperatures, its fibers lose their flexibility and become brittle at a temperature only sufficiently high to deprive it of the water which forms a part of its composition.

By the mineralogist the term *asbestus* was originally applied to a finely fibrous form of hornblende; but, as Dana adds, much that is so called is a fibrous form of serpentine. Most if not all the asbestus of commerce is fibrous serpentine. A recent analysis made in the writer's laboratory showed the following composition:

Silica	39·05	per cent.
Magnesia	40·07	"
Alumina	3·69	"
Oxide of iron	2·41	"
Water	14·48	"
Undetermined	·30	"
	100·00	

This mineral has been known from very early times, but it is only within recent years that it has found any extensive applica- tion in the various industrial arts. In ancient Greece the bodies of those who were to be burned upon the funeral pyre were wrapped in asbestus cloth, that their ashes might be kept separate from those of the pyre. In the eighth century Charlemagne is said to have had an asbestus table-cloth, with which, when the feast was over, he was wont to amuse his rude warrior guests by throwing it into the fire, and in a short time withdrawing it cleansed and uninjured.

On the other hand, the first Canadian deposit was opened only in 1878, and the owners experienced considerable difficulty in disposing of their output, which for the season did not exceed fifty tons. In 1889, with a Canadian output for the year of nearly five thousand tons, the demand is in excess of the supply, and is increasing, with prices showing an upward tendency.

The asbestus of commerce is the product of two widely separated countries—Italy and Canada. The Italian article was first in the market, but the Canadian product soon made for itself a place and a name, and the mineral is now shipped from Canada to Italy; while toward the close of 1889 the United Asbestus Company, Limited, of London, England, which controls the Italian mines, acquired property in the Canadian field, and is equipping the same with a complete plant preparatory to operations on a large scale. It is very evident, then, that the Canadian fiber is, to say the least, no mean factor in the asbestus industry.

Canadian asbestus occurs in serpentine, being, as already explained, a fibrous form of this mineral. In two great geological formations represented in Canada there are extensive areas of serpentine, viz.—the Laurentian, which, beginning on the coast of Labrador, stretches westward beyond the Great Lakes; and the Quebec Group, a formation occupying a large portion of the province of Quebec lying between the river St. Lawrence and the United States boundary. In the serpentine of both these formations asbestus occurs, but as yet it has not been proved that the asbestus veins of the Laurentian serpentines are sufficiently persistent to warrant mining operations. It is not improbable that productive areas may yet be found in the Laurentian rock, as prospectors are now turning attention in this direction. But at present it is only in the serpentine of the Quebec Group that productive mining is carried on.

In this formation there is a belt of serpentine rock "which extends with tolerable directness, though with frequent breaks, northeastward from the Vermont boundary to some distance beyond the Chaudière River," which flows into the St. Lawrence near the city of Quebec. Throughout the whole of this belt there are indications of the occurrence of asbestus, but the present productive area comprises only a very small portion of this extensive belt. Although good workings occur elsewhere, the great majority of the mines are along the line of the Quebec Central Railway, which runs from the city of Quebec to Sherbrooke, the capital of the so-called Eastern Townships of Canada, and cluster around two points a short distance apart and about midway between the two cities. In this district the serpentine forms a very rugged country, rising into bold peaks and ridges, the ruggedness and boldness being enhanced by numerous faults and dislocations of the rock. Bush-fires have recently passed over much of it, and the partially burned trees, with the scarred and seamed rocks as a back-ground, constitute a somewhat drear and dismal scene.

In the serpentine the asbestus forms irregular veins, varying from mere threads to four, six, and occasionally even more inches in width. The fiber is always at right angles to the sides of the vein, unless thrown otherwise as a result of faults. In some cases the mineral has been found concentrated in pockets, from which several tons have been taken. The color of the asbestus in the veins is white, greenish, or yellow, but near the surface the veins are frequently more or less discolored from infiltration through the shattered rock of water carrying oxide of iron. At a depth, and where solid rock is reached, this trouble usually ceases. The asbestus veins are frequently traversed by bands of foreign matter, such as compact serpentine, chromic and magnetic iron, and these, of course, lessen the value of the veins in which they occur, since they cut up the fiber and must be removed at considerable trouble.

Associated with the asbestus one usually finds a considerable quantity of coarsely fibrous mineral, for which, as yet, no use has been found, together with foliated and slaty forms of serpentine. Some of the latter are of very singular appearance. To use the words of an English gentleman who spent some time in the Canadian asbestus region, "Many of these fragments, as they lie on the ground after blasting, have so much the appearance of a wood-cutter's choppings that, if placed side by side with actual choppings from rough timber, exposed to the weather, the one could in no way be distinguished from the other except, of course, by handling." Others, again, in color and shape very much resemble strips of fancy confectionery.

Still another singular associate of the asbestus is a mineral of a white or green or yellow color, occurring in thin veins. When first exposed it is so soft that it may be easily indented by the finger-nail, but on contact with the air it soon hardens and assumes an appearance somewhat like porcelain. Analysis shows it to be closely related to serpentine.

Mining is carried on by cutting down the hills of asbestus-bearing serpentine, much as a farmer cuts down a stack of hay or straw, or by open quarrying on the level. The rock is blasted out and the asbestus, separated from the containing rock, is "cobbed"—i. e., separated by hammering from adhering foreign matter. This "cobbing" is a comparatively easy matter in the case of the finer quality, as it usually separates readily from the gangue, but in the lower grades much difficulty is experienced in separating the fibrous matter from the non-fibrous. At best there is great waste. Much of the asbestus is in thin or narrow veins, and is wasted, as by the present mode of operating it does not pay to separate this from the serpentine. A machine that will enable these narrow veins to be utilized is a desideratum.

When "cobbed" the asbestus is graded according to purity, color, and length of fiber into three grades and bagged for shipment. The finest quality or "firsts" finds ready sale at prices ranging from $80 to $110 per ton; "seconds" fetch from $50 to $70 per ton; while "thirds" may be valued at $13 to $15 per ton. In good mines the yield of asbestus is from three to five per cent of the rock quarried, and the cost of mining may be put down at $25 to $30 per ton. Returns obtained by the Geological Survey of Canada show that, for the year 1888, Canada's output was 4,404 tons, valued at the mines at $255,000, and this the output of nine different mines. Over three fourths of the whole was shipped to the United States; small quantities going to Great Britain, Germany, France, Belgium, and Italy, and being used in domestic manufacturing.

Judging from the results obtained in the mines now worked, and the indications in other parts of the serpentine belt, it may be safely said that the asbestus deposits of Canada are well-nigh inexhaustible. There is every prospect that the industry will rapidly expand, as capitalists are turning attention to it, the work hitherto done "proving conclusively that mining for asbestus, when properly conducted, shows a more steady return for the money invested, with less elements of risk, than mining for any other known mineral."

Upon its non-conducting power and its ability to resist high temperature depend the many varied uses of the mineral. First and most important are its applications in connection with the steam engine and boiler. For packing pistons, flange joints, hot-air joints, cylinder-heads, and similar purposes, asbestus has proved itself invaluable, and for these purposes it is spun into yarn or wicking or rope, or made into mill-board. A large quantity is manufactured into a kind of felt, either alone or, in some cases, along with other fibrous material. Much of this asbestus felt is used as a non-conducting covering for steam-pipes. It is made into sections to fit any size of pipe, and into rolls and sheets for large surfaces. It is in use on the war-ships of the United States Navy, and has there and elsewhere been demonstrated to be superior to hair-felt as a non-conductor. By preventing radiation of heat from steam and hot-air pipes, this felt effects a large saving in fuel and gives dry steam at long distances from the boiler, and, by preventing excessive warmth of the boiler-house, adds much to the comfort of the workmen. The felt also finds application as a sheathing for covering wood-work in positions exposed to heat, and for fire-proofing flooring, shelving, partitions, and the like.

As far back as 1850 the Chevalier Aldini of Milan, experimented with asbestus, mainly with the object of turning it to account in the manufacture of asbestus cloth, but little success was met with until twenty years later. The unctuous character of the substance and the extreme fineness of the ultimate fiber are obstacles in the way of making asbestus cloth that shall be strongly coherent and not pull asunder easily. These difficulties appear to have been overcome to a great extent, and now in the form of woven fabrics there are many important applications of asbestus. To one of these, in particular, the attention of the public is frequently directed, because of the numerous fatal fires reported in theatres, music-halls, and similar places of entertainment. In the great majority of theatre fires the flames begin in the stage curtains or drapery. When these are made of asbestus, of course they are incombustible; or, if the curtain alone be of asbestus it affords a means of separating the stage from the body of the theatre, and, in case of fire in the former, prevents its spread to the auditorium. Asbestus curtains are now in use in the principal Roman theatres, and in many theatres in German, English, and American cities, much to the advantage of the theatre-going public. The mineral is also made into gloves, stockings, and other garments; in fact, complete suits of asbestus clothing can be obtained. In Paris the firemen of the city have recently been furnished with entire suits of asbestus cloth, and it is said to be probable that London will soon follow the example of the French capital.

In the form of gloves it is of much service to stokers and furnace-men, and as salvage blankets it is of great value. It is announced that mail-bags will, in the near future, be of asbestus. The frequent loss of mail matter by fire, in connection with railway accidents, renders it desirable that some incombustible material be used for this purpose.

Much of the lower grade of asbestus is ground up with other materials and made into cement and paint. The former is extensively used as a non-conducting covering for boilers and steam-pipes. Being a cement, it can not be readily removed without much labor and loss, so that it is somewhat less convenient than the felt, which, as already mentioned, is used for the same purpose. It is, however, very much cheaper; and this, in the estimation of many, more than compensates for the less convenient form. Certain it is that much more cement than felt is used as a non-conducting covering.

The paint finds extensive application; a layer of it, while not rendering a wooden surface absolutely fire-proof, is yet proof against sparks and slight flames, and thus prevents the spread and increase of many an incipient fire.

In the form of rope it is used in the construction of fire-escapes and supports that may have to withstand fire. We have also asbestus paper. As a wall-paper it aids in rendering a building fire-proof. In the form of writing and printing paper it presents a fire-proof paper that may be used in valuable legal and commercial documents.

Not only does our mineral resist high temperatures, but it is also proof against the action of the majority of chemicals. It therefore forms a very valuable substance for use in filtering apparatus, especially where acid and alkaline liquids which corrode ordinary filtering paper and cloth have to be dealt with. As a filtering medium it is used not only in chemical laboratories, but in manufacturing establishments as well.

Though the asbestus industry is only in its infancy, many other uses might be mentioned; but, bearing in mind that it is possible to produce from it fire-proof fabrics of any form or shape, there will readily occur to the mind of the reader many other possible applications of this curious product of Nature's laboratory which has waited so long for an opportunity to minister to the comfort, convenience, and safety of man.

CHRYSANTHEMUMS.

By JEAN DYBOWSKI.

EVERY season has its peculiar flowers. Even in our extremely irregular climate there are few times in the year when we can not have some pretty blossom to admire. The explorations that are made into all the quarters of the globe, with importations that have followed them, have endowed our flora with such a number of varieties that we may say we have only to choose from among them to get the handsomest there are. There are few flowers that do not wear an infinite charm, and very few are those which fail to make an impression with their elegant form and fresh colors. Some among them, however, unite in themselves such combinations of qualities that they are lifted above their fellows, and occupy a place of honor among us. Of these, those that are late in blossoming offer a special interest. Among the plants of this class which the public justly regards with the highest favor are the chrysanthemums. Few plants combine so many desirable qualities as they; abundance of blossom, richness in coloring, elegance of form, and long duration, are some of their leading qualities.

The plant has been known from very ancient times, and the beginning of its cultivation among us dates from several hundred years back; but it was for a long time neglected, and only a few varieties were known, whose small, imperfectly shaped flowers gave no indication of what could be made of them if special attention were given them. Now the varieties are counted by hundreds. Some have been directly imported from China and Japan, but the most of them are of French or English origin. Intelligent sowing and careful selections have given unanticipated results; and several types have been developed which are quite distinct in the form and arrangement of their flower-rays.

The flowers are originally of a similar disposition to those of the field daisies. By cultivation they have been made double—that is, all the minute flowers in the center have been endowed with large corollas like those constituting the white border of the daisy. Then the form of the corolla has varied so as to appear under very distinct types. Sometimes the petals curve upon themselves, so as to form a regular large head, as in what are called the Indian chrysanthemums. Others curve outward and give a more open form to the whole, as in the Chinese chrysanthemums. In others, again, the corollas deviate in every direction, constituting an odd, irregular type, but marked with a special artistic elegance, as in the Japanese chrysanthemums.

Chrysanthemums were formerly regarded as garden plants; they are equally house plants. There are few plants so well adapted to the ornamentation of our dwellings, whether they are treated as cut flowers or pot plants. For bouquets, only the orchis can rival them in lasting qualities. If cut in full bloom and kept in water, they will last two or three weeks; but the water should be renewed often, and kept pure with charcoal. Bouquets of exceeding elegance can be made of chrysanthemums. The flowers should be cut with as long stems as possible, and placed, after stripping the leaves from the lower ends, in a wide-mouthed vase (Fig. 1). The bouquet then has the appearance of a sheaf in which each flower displays its full beauty, and, by contrast of color and form, heightens the effect of its neighbor. A special business is made of growing flowers for these bouquets. In this cultivation all the flowers except the terminal one are suppressed on every branch, whereby the flower that is left reaches a large size. The plants thus treated are cultivated under glass, and copiously manured in order to give them great vigor. Flowers have been thus produced measuring not less than twenty centimetres in diameter (Fig. 2). Assiduous care is given to all the details in raising these flowers. The petals are fashioned by hand, and are given the desired curvature, and put in determined positions by the aid of ivory pincers. A single flower thus produced will bring from two to four shillings.

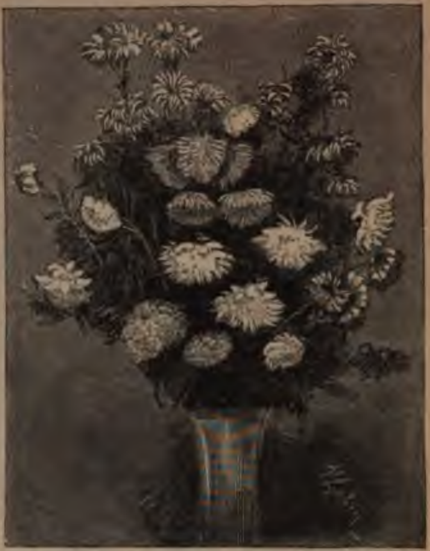

Fig. 1.—Bouquet of Chrysanthemums.

The effort to produce such exaggerated specimens can, however, not be regarded as a well-directed one. Overgrown flowers lose in beauty, and extreme regularity of shape is obtained at the expense of grace, and of the great charm of the flower, which lies chiefly in an unexpected novelty of form, and the special stamp of originality that gives each blossom an expression of its own. We might as well make them out of paper at once as treat them so that they shall all be alike.

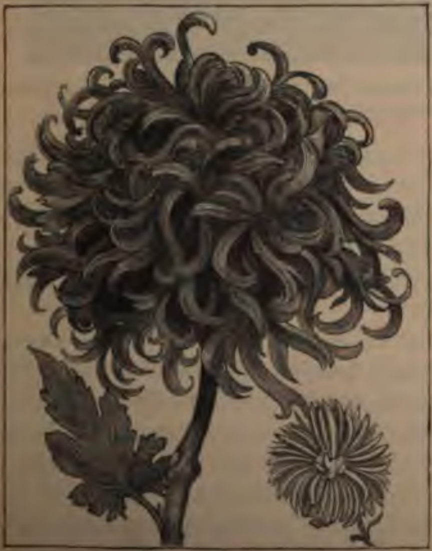

Fig. 2.—Large Chrysanthemums (reduced).

The November chrysanthemum exhibitions of the horticultural societies are growing in importnace. The superb plants that are now shown at them are counted by the thousand. The house of Levêque, which obtained the chief prize at a recent exhibition of the National Horticultural Society of France, had six hundred distinct varieties.

Europeans are not alone in their admiration of beautiful flowers. Some other people, having a fine artistic taste, entertain an enthusiasm for them that rises to a passion. With the Japanese, who love flowers above every other decoration, the chrysanthemum holds the place of honor, and, as the golden chrysanthemum, is the highest national decoration. It is usual with them to name women after flowers, and "Madame Chrysanthemum" is much favored. A custom prevails among them at chrysanthemum-time of covering human figures with a coating of clay and arranging chrysanthemums upon them, in colors, in imitation of their dress-goods; these manikins may represent men playing some scene of action (Fig. 3), or women making or offering tea (Fig. 4). The figures are placed on exhibition, and an admission fee is charged for seeing them.

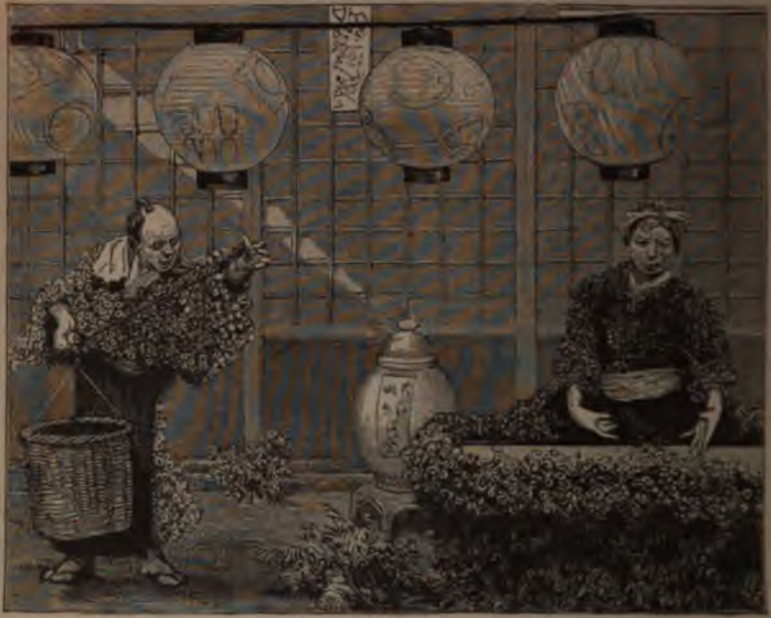

FIG. 3.—JAPANESE MANIKINS, PLASTERED AND DRESSED IN CHRYSANTHEMUM FLOWERS. (From a photograph.)

Not all chrysanthemums can be cultivated here in the open air. Some of the choicest varieties, true to their Eastern origin, are too tender for our chilly autumns, and need to be sheltered. But they pay well for the attention, by preserving a brighter verdure, and fresher and more brilliant colors. Some effort has been made, by heading in and otherwise trimming the plants, to make them grow into particular shapes, but the practice has not become very extensive.

Chrysanthemums thus combine the advantage of blooming in the autumn and late into the winter, and submitting to various trimmings, and assuming diverse aspects. The cultivation of

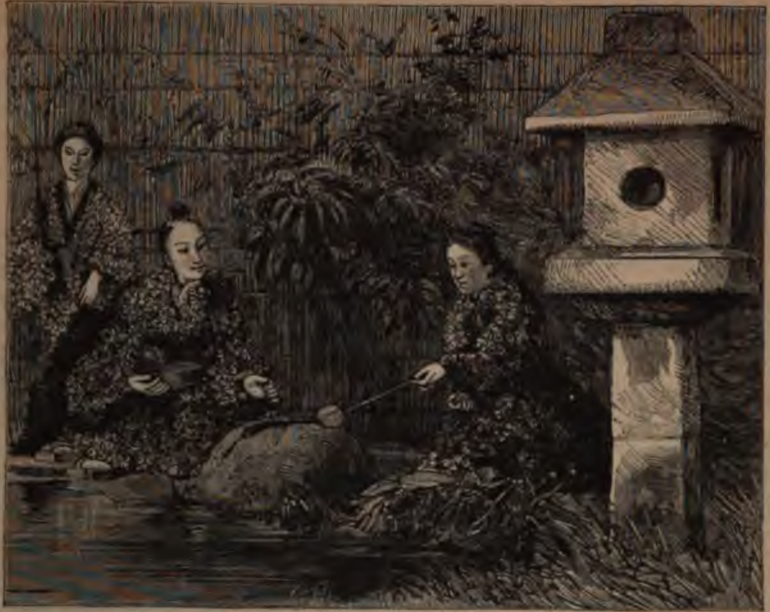

FIG. 4.—JAPANESE MANIKINS, DRESSED IN CHRYSANTHEMUMS, REPRESENTED AS MAKING TEA. (From a photograph.)

them will, no doubt, go on increasing, for they are justly, on account of the many desirable qualities they combine, appreciated very highly.—*Translated for the Popular Science Monthly from La Nature.*

RAINFALL ON THE PLAINS.

BY STUART O. HENRY.

THE general impression seems to be that the rainfall has increased and is increasing on our "plains" because of their settlement and cultivation. It is fancied that, as the population moves westward, augmented precipitation follows, so that there is now sufficient rain where ten or twenty years ago it was too dry. Travelers who ride swiftly across this region in a day find towns and catch glimpses of farming operations where five years ago they saw but a barren waste. They conclude that a marked climatic change has taken place, and infer that it can only be due to the presence of population. They fancy that the cultivation of the land must produce marked hygrometric results. That this is a remarkable fallacy becomes certain when attention is called to the evidence.

In the first place, neither history nor science gives any testimony to show that the tillage of the soil and the planting of trees have any appreciable, to say nothing of a considerable, effect on the climate. Even in irrigated countries only a barely perceptible increase in the rainfall has been discovered. In Spain, France, and Italy, irrigation is now not only required for farming, but it is more widely practiced than ever before; yet, if the "rain-belt" theory were correct, these countries would long ago have had sufficient precipitation for successful agriculture. There is scarcely any rainfall in the valley of the Nile to-day, after centuries of cultivation and of annual floods.

Our "plains," or arid region, lie east of the Rocky Mountains, and are at least four hundred miles across. Although the precipitation gradually decreases as one proceeds westward from the Missouri River, it is difficult to fix an isohyetal line. But the line is somewhere between one hundred and two hundred miles west of the Missouri, as the flora clearly shows. It seems to have been taken for granted that the plains were treeless and well-nigh grassless because of lack of rain. Whether the absence of trees is ascribable to the pulverulence of their soil, or the germless lacustrine deposit which covers them, or the excess of moisture, or the fires of the Indians, it is clear that it is not due to rainlessness, because the dry hill-tops in the midst of the arid region have some trees. In other words, there is no evidence whatever that the precipitation on the plains to-day is any greater than it was fifty or one hundred years ago; and there is every reason to believe that it is less.

But, it is said, the observations west of the Missouri show a material increase in the rainfall. This is not true. In the reports of the Kansas State University and the Kansas State Agricultural College we learn that the rainfall for the ten years from 1879 to 1888 is not so great as that of the previous decade. One authority on the subject has recently taken, among other series, the observations at Fort Leavenworth from 1837 to 1883, and, testing by the proper mathematical processes their variabilities and probabilities, demonstrates that there is no indication whatever of permanent climatic change. Yet Fort Leavenworth is one hundred and fifty miles east of the eastern line of the dry region.

It must appear irrational to any one, after a moment's reflection, that the settlement of five or six thousand people in a county usually twenty-four by thirty-six miles in dimensions, and the tillage of a small part of its area, would so materially increase the rainfall in the brief period of ten or twenty years as to make agriculture successful and profitable where before it was not possible. Extending these limits to the wide expanse of States does not make the idea any more tenable. Yet on such conditions as these the theory as applied to our plains is based. The reports of the Nebraska and Kansas Boards of Agriculture will show that, in the territory lying west of the ninety-eighth meridian in those States, the acreage of land actually under cultivation, when compared with the whole area of that territory, is almost insignificant. The climate, as well as the law, pays no heed to small things.

It would not answer for the advocates of the theory only to claim that precipitation would be augmented *somewhere*, and not necessarily in the certain region where is found the increase of farmed lands; for it would then be very reasonable to suppose that the prevailing southwest and west winds of the plains would drive from them the moisture which the farmer there had earned. Iowa, Missouri, and eastern Kansas, instead of the dry region, would get the increased rainfall.

Prof. Frank H. Snow, of the Kansas State University, said several years ago: "But the fact that thousands of new-comers, from ignorance of the climate, have attempted to introduce ordinary agricultural operations upon the so-called plains, and have disastrously failed in the attempt, has placed an undeserved stigma upon the good name of Kansas in many far-distant communities, and has undoubtedly somewhat retarded immigration during the past few years. It is time for the general recognition of the fact that, except in the exceedingly limited area where irrigation is possible, the western third of Kansas is beyond the limit of successful agriculture." The severe seasons of drought which have occurred since the above conservative statement was written show the whole truth of the matter to be that the westward advancing line of settlement is by no means an isohyetal one, but that it is merely a line representing in a way the overflow of the population of our Eastern States. It needs but a slight acquaintance among the old settlers in central Kansas to know that they fear nowadays excessively dry weather as much as they did twenty-five years ago. The people who live farther west are losing faith in the idea of an increased rainfall, as is evidenced by the fact that over two hundred linear miles of main canals have lately been constructed for irrigation purposes nearly as far east as Kinsley, in the Arkansas Valley of western Kansas. In the Platte Valley, in Nebraska, large irrigating systems are at present being projected.

He who would provide the plains with an ample precipitation must remove the Rocky Mountains. Is it reasonable to suppose that three or four telegraph lines, small bunches of stripling trees here and there, and the turning over of a few thousand acres of sod, can be of any avail in changing a great dry territory into a garden? Can man so easily control Nature and her laws? Certainly not. Climates are immutable so far as the puny efforts of humanity are concerned. And it is a grave fallacy, for on the strength of it hundreds of families are induced each year to locate on the plains with the expectation of farming successfully. Failure follows, of course, and their only hope is to sell out to trustful new-comers, and move where the natural conditions are favorable to agriculture and the prosperity of farm-homes.

LONG FASTINGS AND STARVATION.

By M. CHARLES RICHET.

WHAT takes place in an animal deprived of food may be explained by recurrence to the comparison between the animal and the machine, which, though very old and commonplace, is still exact and almost inevitable. In the machine, the burning of carbon gives rise to heat and force; animals also, burning carbon, develop heat and force. The same is true of plants, for they likewise disengage heat and force; only the plant disengages very little, and the animal much of them. While the plant is stationary, fixed to the ground, the animal is forced to move to find food. We might, indeed, say that all its wonderfully complicated organism is in substance only an apparatus attached to the stomach. The lower animals are hardly anything else than a stomach adapted to motion; and the animal is improved as its means of seeking food everywhere and at a distance are perfected. The animal goes out in search of food because it feels a want—hunger. Nature, in fact, distrusts the intelligence of her children, and for that reason has given to all living beings instincts and wants; and has armed them all, without exception, with the sensation of hunger, to provoke them to seek nourishment. Without this irresistible feeling no being could live.

The sensation of hunger is a painful feeling of uneasiness and weakness. It is a general feeling, but is localized apparently in the stomach. Many ancient authors regarded it as a local sensation. Some said that the gastric fluid became more acid and produced a burning feeling in the stomach; others, that a contraction of the stomach took place. But, although the sensation of hunger is related to the stomach, it is really general. While it is sometimes alleviated by swallowing earth and stones, such inert substances may deceive it, but do not appease it. It has, moreover, been experimentally determined that the feeling of hunger is not abolished after cutting the pneumogastric or sensitive nerve of the stomach.

So, in thirst we feel a dryness in the back part of the throat. The local sensation is deceptive, for thirst does not depend upon any condition of the mucus of the pharynx. It is caused by the exhaustion of the watery elements of the blood. It is therefore removable by injections of water, and by bathing, when water is absorbed by the pores.

If hunger is not satisfied, it disappears after a certain length of time. The most intense suffering is endured during the first twenty-four hours, after which the pain diminishes. The characteristic phenomenon exhibited by an animal subjected to starvation is the constant diminution of weight. I have made many experiments on this loss, comparing animals of various sizes, and have determined that the function of dehydration—or reduction of weight—is in direct relation with the size of the animal; and I believe that I can deduce a great rule of comparative physiology that the activity and intensity of all the functions are determined by size. Carnivorous animals appear to bear fasting better than herbivorous kinds. The latter eat nearly all the time, and are ill when they have to stop; but carnivorous animals, in the wild state, are often forced to endure abstentions of considerable length; and a fast of several days is almost a physiological condition with them.

When we examine the phases of the loss of weight of a starving animal, we find that it loses much during the first days. Then a moderate drain sets in. Again, in the last days considerable loss takes place, and this is the forerunner of death.

Cold-blooded animals can support inanition during a prodigiously long time. M. Vaillant has told me of a python weighing seventy kilogrammes that lived twenty-three months without eating; M. Colin, of a rattlesnake that lived twenty-nine months. Redi mentions a tortoise that lived eighteen months, and a frog sixteen months, without food. When we have frogs in our aquariums waiting to be experimented upon, we never feed them and they never starve. Dogs can endure abstinence, on the average, of thirty days; cold-blooded animals, twice as long. They are capable of this, because their tissues are consumed more slowly, and do not require so frequent renewing. With both classes the fatal limit is reached when the loss of weight amounts to forty per cent. This point is reached by the warm-blooded animal ten times as quickly as by the cold-blooded one, because its nervous system is ten times as active. The relation of the nervous system to the intensity of the chemical exchanges of vital action is shown by the existence of hibernating animals, or warm-blooded animals which periodically become cold-blooded. Becoming torpid at the approach of the cold season, their breathing and circulation become slow, their motions weaker, their eyelids close, they fall into their winter sleep, and their temperature descends to about 40° Fahr.

The nervous system is the great inciter of nutrition: when it is vigorous or excited, the digestion is active, the breathing rapid, and the temperature high; and the loss of weight and the possible duration of abstinence follow the same rule.

Man is subject to the same conditions in case of fasting or starvation as warm-blooded animals; and the influences of size, age, and nervous constitution are similar upon him. This is illustrated, in respect to age, in the legend of the family of Ugolin, in which the youngest child died first, at eight years of age, and the other children followed, while the father did not die till three or four days after the death of the last of them. So, in the wreck of the Medusa, the children died first on the raft, the old men next, and the adults last. We might have supposed that the old men would have resisted better; but while they may, perhaps, bear moderate fasting with less inconvenience than more active persons, they are less able to endure starvation. New-born infants are less capable of resistance than adults; but the young of animals—puppies and kittens—are more hardy than we would be ready to suppose. Experiments on new-born children have shown that they can offer considerable resistance to external influences, provided they are well fed. Their mortality is principally due to a deficiency of alimentation called athrepsy, infants dying of which present the same lesions as starved animals. Their fat is exhausted, while the weight of their nervous system is not reduced. Another feature of the starvation of infants is a relative increase in the globules of the blood by dehydration; not that the number of globules is greater, but the proportion of them to the whole volume, a considerable portion of the water having disappeared.

The duration of the possible fast is considerably influenced by fever. That is supposed to determine the production of poisons which stimulate the nervous system and intensify the process of denutrition; so that under its influence, as has been observed in experiments on animals and in man, the weight diminishes more rapidly than under starvation alone.

The influence of drinking is also noticeable. Of two dogs observed by M. Laborde, one died in twenty days; the other, which could drink at will, was still living at the end of thirty-seven days. There are also examples on the other side. Falck's dog went sixty-one days without drinking or eating. Starving dogs usually drink but little, as if warned by instinct not to drink more than they have to. Water, in fact, expedites the wasting of the tissues and accelerates the drain of the salts in the organism. Hence, by drinking, we excrete more chloride of sodium, phosphates, urea, etc., so that, although in general animals deprived of water do not live as long as those which can drink, there is some difference between those which can drink a little and those which drink a great deal. The last die sooner.

There is always less suffering when it is possible to drink; for it is a characteristic of privation that thirst torments more than hunger, and those who have told of what they have suffered on such occasions have usually emphasized this fact. But I do not believe that the hour of death is much delayed by the ingestion of drinks.

In considering cases of fasts endured by men, we have to distinguish between the *experimental fast,* carefully arranged for and limited to a certain number of days; the fast which I call *charlatanish;* and the *compulsory fast,* which is inflicted upon persons who have been surprised by accidents, such as shipwrecks or land-slides, or who have been left in the wastes of the desert.

EXPERIMENTAL FASTS.—Mr. Ranke, a German physiologist, felt no great inconvenience for forty-eight hours, and his worst sufferings were in the earlier stage. His symptoms were great muscular weakness, impossibility of sustaining prolonged movements, fibrillary shiverings, and headache. The most striking phenomena were insomnia with nightmare and throbbing in the head. Beginning nineteen hours after he had taken his last food, he determined by experiment what was his daily diminution of weight, and the rate of consumption of carbon and nitrogen per kilogramme and per hour. He found that the consumption of carbon was twenty times that of nitrogen; that he lost in weight about 1·2 gramme per kilogramme per hour; and that he produced fourteen litres of carbonic acid per kilogramme per hour. The last number is important. In the normal condition we produce eighteen litres of carbonic acid per kilogramme and per hour. As Mr. Ranke's case was not one of illness or any kind of weakness, the question arises as to the purpose served by these four litres of surplus carbonic acid. The most obvious answer is that they are a luxury. In some experiments which I made, the rate of production by my subject, while fourteen litres during the fast, rose by one third after he had eaten a hearty meal, and his respiration increased in a like proportion.

In the cases of the celebrated fasters Tanner, Succi, and Merlatti, while it may be hard to prove that there was no fraud, the precautions taken against it seem to have been ample to make it extremely improbable. They, moreover, all endured their fasts under special conditions. Merlatti ate a fat goose, bones and all, before beginning; Succi took a drink to which he attached great importance. The diminution of weight was less considerable than in the other subjects mentioned, but in Merlatti's case the whole amounted to twenty-seven per cent at the end of the fifty days, and there was great danger of a fatal result from the enfeeblement of the nervous system. The faster persisted in going on to the end, after being advised to discontinue the experiment, and vomited immediately after taking the first food. Nevertheless, he presided at a banquet given in his honor, and fully recovered in two months. Cetti, whom M. Senator put on an experimental fast of ten days, and who drank all the water he wanted, lost more weight during the first than during the second five days.

In view of other facts showing less capacity to endure long fasts, we have to conclude that such persons as Tanner, Succi, and Merlatti performed their experiments under exceptionally favorable conditions. They had no severe weather to face, no concern about their fate, and knew that they had only to make a sign to have a savory repast brought to them. Quite different is the situation of persons who have been buried, for example, under landslides. Cut off from the rest of the world, they know that no help can come to them for the moment, but that to reach them tunnels must be bored and large masses of earth and stones removed. Long privations of food have often to be suffered under such conditions. Berard mentions men who were confined for fourteen days in a damp cellar. Licetus was shut up for seven days. The miners of Bois Mousil were confined for eight days after a landslide, without suffering greatly.

Other examples are afforded by shipwrecked persons. There is an interesting story of a party wandering on the ice-fields who were exposed to a terrible cold for seventeen days, in 1809, without other nourishment than water thawed from sea-ice. When found, their skin was sticking to their bones, their eyes were sunk deep in their orbits, and they had fetid breaths and earthy complexions, their skin was covered with a sooty scurf, and their tongues were black. This sooty aspect of the skin is a common symptom in great famines, such as occur in India and China.

We have many instances of individual fasts. An Italian seventy-seven years old, mentioned by MM. Monin and Maréchal, lived without food to the thirty-seventh day, only drinking occasionally a little brandy and water; then went to eating again without feeling any inconvenience. A man named Granie, condemned to execution, starved himself to death in sixty-three days. Antonio Viterbi, in 1821, allowed himself to die of hunger in order to escape the penalty of death. He had also resolved not to drink; but at one time, taking water in his mouth to refresh himself, he could not restrain himself and swallowed it. He had vertigo and nightmare, but suffered most from thirst, and died on the seventeenth day. This period, from seventeen to twenty days, represents the mean duration of life of a man in normal conditions who is starving. But Simon Goulart tells of one

Hasselt who was found alive after having been shut up for forty days without food.

Succi and Merlatti were perhaps insane or melancholy. Persons who are taken in good health resist less effectively than maniacs. M. Lepine cites the case of a girl who had constriction of the œsophagus, who died after having lived sixteen days without food or drink. There is also the extremely interesting case of a German merchant who, having been unfortunate, went into the woods to starve himself to death, and died after eighteen days. He was still breathing when discovered. He had noted down his impressions daily. After five days he wrote: "If I only had fire, a little fire! How long the nights are—how cold they are!" On that day he drank. Three days afterward, cold water which he tried to drink made him vomit. A week after that he tried to go to the water, but his strength failed him and he stuck to his resting-place. During these eighteen days of suffering he therefore drank only once. These periods of nineteen, seventeen, and sixteen days, in persons not out of their minds, justify the estimate of twenty days as the length of the fast which will bring death to healthy persons under no nervous waste. But the time admits of a considerable extension among insane persons and those who have made preparations for their fast. Succi, who fasted thirty days, had been twice in an insane asylum. Cardan relates the case of a Scotchman who lived thirty days in a prison without eating. Devilliers, in the "Journal de Médecine," mentions an insane person who died after seventy-five days of partial fasting, in which he took only a few glasses of liquid—a little wine and bouillon. The amount of weight lost at death can not be closely determined, but may be estimated at about thirty per cent.

These conditions relate to sound or nearly sound persons. Respecting the stories told of diseased persons, we have to steer between a Scylla and a Charybdis of excessive credulity and excessive incredulity. A Prof. Licetus, of Padua, near the beginning of the seventeenth century, wrote a rather stupid folio in Latin, "On those who can live a Long Time without Food." It contains various chapters, on "those who live eight days"; "those who live a month"; "those who lived three months"; "those who lived from one year to eight years"; "those who lived more than twelve years"; and ends with the story of the seven sleepers of Ephesus, who went to sleep in the reign of the Emperor Decius and woke in that of Theodosius. We can more than doubt some of the stories of Licetus; but there are facts as remarkable as some of them, concerning long fasts by diseased infants and girls, which we can not question.

The excessively long fasts, whether experienced by men, women, or children, have usually been observed in hysterical persons—for it is now known that hysteria exists in men and children as well as in women. Taking up almost any of the numerous stories related by the old authors, we find manifest traces of hysteria in them. Here, for example, is "the memorable and prodigious history of a girl who for many years neither ate nor slept nor voided, and yet lived by God's admirable grace and virtue" (Frankfort, 1587). She was Catherine Binder, of Heidelberg, who at twenty-seven years of age all at once lost the taste for warm food (a hysterical fancy), and ate nothing warm for five years, when she was treated by a quack, and also lost the taste for cold food. She neither ate nor drank for seven years. While we may entertain some question respecting the accuracy of this affirmation, there is no doubt that the girl was nervously affected. She had been deprived of hearing and speech for three years; she had spasms when she tried to eat, so that she could not swallow; and, during two weeks that she was watched, she neither ate nor drank. Another girl (1586), religiously affected in her hysteria, was taken with an aversion to everything eatable, and a difficulty in swallowing, and lived for four years on nothing but water and, at long intervals, a little bread dipped in water. Apollonia Schrierer, of Berne (1604), lay physically insensible but wide awake day and night. She was kept apart from her mother and constantly watched by the officers for two weeks, during which she took no food. In the same book with this story is that of a girl of Spires, watched for twelve days, who was assumed to have lived for three years upon nothing but a few drops of water or wine, which she took in her lips. She was twelve years old, and slept most of the time. A girl of Cologne, who lived four years without food, fainted whenever they tried to put anything into her mouth. Passing over several other cases related by these old authors, which vary but little in their general features, we come to a number of cases recorded in medical publications of the eighteenth century, in all or nearly all of which the long fast is accompanied by some kind of disorder of the body or mind. In many of these instances, as in some of those described above, the fast was not absolute, but was occasionally relieved by the introduction of a few drops of milk or broth. Such a fast can be continued indefinitely—as in the case of a woman described by Vandermonde in 1760, who lived thus for twenty-six years.

The present century furnishes numerous fairly well authenticated instances of extraordinarily long fasts, which were nearly always associated with some form of hysteria. We can not mention them all here, and omit those which are most frequently cited in the medical books. Anna Garbero is described by Ricci as having, after a sleep without eating of forty days, been taken on the 8th of September, 1825, with an absolute repulsion against food, and thus continued till the day of her death, after a lethargic sleep of three months, on the 19th of March, 1828. The autopsy disclosed a contraction of the sigmoid flexure of the colon. One of the most extraordinary cases on record is that of the Dutch hysteric Angelina de Vlies, forty-one years old, who continued without food from the 10th of March, 1822, to 1826. She was subject to cramps and tremors, and was very weak, and not able to rise without help. Bourneville and D'Olier tell of an idiotic child who at two years of age lived three weeks, and at seven years twenty-eight days, on nothing but water and broth. In many similar cases, the patients have eaten occasionally, but only the minimum quantity indispensable for the maintenance of life. Thus, a woman cited by Lasègue only ate during a year what an ordinary person would require for two days.

One of the characteristics of cases of this kind is the extraordinary perversion of appetite. An insatiable craving prevails in some of the patients, a loathing in others. Perversions of the sexual passion have also been remarked. With these fantastic tastes is associated an exceptionally strong and enduring power of resistance.

There was for a long time at the Salpêtrière a woman named Etchverry, who had hemiplegia on one side and contracture on the other. Her hysteria should apparently have provoked a general denutrition, but it did not. She would not eat, and had to be fed artificially. Her excretions were marked by an extreme deficiency of urea. There was no deception in her case, for she was under constant watch.

I have observed in a very precise experiment the diminution in the phenomena of nutrition in hysterics. M. Hannot and myself, studying two hystero-epileptic cases at the Salpêtrière, found that the patient in a condition of lethargy received only four litres of air into her lungs in sixteen minutes, and made only eight inspirations in thirty-six minutes. This marvelous slackening of the respiratory phenomena constitutes a real hibernation in man, resulting from the absence of stimulation of the nervous system.

Observations have been made of a disease of somnolence. M. Charcot has recently published an account of a case, and MM. Semelaigne and Gélineau have published another. An irresistible torpor takes possession of the patients, who fall into a sleep in which all the phenomena of nutrition are slackened, but the sleepers wake occasionally and take food or perform physical offices.

The fakirs of India, who allow themselves to be buried alive, belong to the same category. They submit to extraordinary mortifications, eat but little, abstain from meats, and use curious arts to empty their stomachs. Having hypnotized themselves, they rest almost without breathing. While much of this may be imposture, there are, according to Rousselet and Jacolliot, some well-authenticated cases of the kind. English sentinels were set around one fakir who was buried alive. When disinterred he was apparently dead, but was aroused and lived. I do not consider it necessary to question the correctness of the cases of lethargy and apparent death recorded in the books. A considerable depression of the nervous system accompanies all such phenomena, and the activity of the heart and the rhythm of respiration disappear at a certain stage of the disease.

There have not been many experiments on this subject made upon men. We have one, however, from M. Debove, on the influence of suggestion upon hysterics. On his indication to two patients that they should not eat or drink, they comfortably supported a fast of fifteen days, with only slightly proportionate decrease of weight, and they had had hardly any feeling of hunger at the end of the period. For comparison, M. Debove tried to impose a fast on a vigorous man, but was obliged to suspend it after five days. This subject lost at the rate of 0·8 gramme per kilogramme per hour, against 0·13 gramme in the hysterical patients. He was not susceptible to suggestion.

We draw from these facts that the functional exchanges are retarded in cases of hysteria. We do not yet know the exact influence of the nervous system. There is certainly a diminution of chemical activity in the tissues which produce heat and in the glands that furnish the secretions. This is not saying much, but it is something.—*Translated for the Popular Science Monthly from the Revue Scientifique.*

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SKETCH OF JAMES GLAISHER, F. R. S.

METEOROLOGY owes to Mr. Glaisher the results of many years of patient labor at the institutions and observatories with which he has been connected; a series of valuable researches undertaken at the instance of the British Association; and those daring and brilliant observations in a balloon at very great heights in the atmosphere with which his name is most conspicuously associated. Yet, as has been observed by one of his biographers, "his numerous contributions to scientific and popular literature, often published in a most unobtrusive manner, which is very characteristic of the man, have scarcely gained him so wide a reputation in the learned world as he certainly deserved."

JAMES GLAISHER was born, according to the "Men of the Time," in London in 1809. In 1829, as assistant in the principal triangulation of the ordnance survey in Ireland, he was charged with the meteorological observations on the Bencorr and Keeper Mountains. These observations were published in 1836. From 1833 to 1836 he was assistant at the Madingly Observatory, near Cambridge; was appointed in the latter year assistant in the astronomical department of the Greenwich Observatory; and was made in 1840 Superintendent of the Magnetical and Meteorological Departments of the same institution, where he remained till he retired from the public service at the end of 1874. In 1865, upon the death of Admiral Fitzroy, he was appointed to the control of the meteorological department of the Board of Trade. From 1841 till very recently he has contributed to the registrar-general's reports the quarterly and annual meteorological reports embodying the results of the reductions and discussions of the observations of about sixty voluntary observers scattered over England.

Among Mr. Glaisher's earlier contributions to the literature of meteorology were the "Hygrometrical Tables," first published in 1845, which has passed through six editions, and is regarded as a fundamental work in connection with the science; "A Memoir on the Radiation of Heat from Various Substances," 1848; certain papers on the forms of snow-crystals, 1855; a report on the "Meteorology of London during the Cholera Epidemic of 1853-'54," published by the Board of Health in 1855; and a report on the "Meteorology of India in Relation to the Health of the Troops," 1863, which formed an appendix to the report of a Royal Commission on the Army in India. In 1857 he conducted the experiments and wrote the report of the Royal Commission on the Warming and Ventilation of Dwellings. He was the founder of the Royal Meteorological Society, of which he was the secretary for nearly twenty years, and the president in 1867-'68. He is a past President of the Royal Microscopical Society.

As a member of the British Association he has been active in the meteorological researches undertaken under the direction of that body; and we find his name attached year after year to the reports on "Luminous Meteors," "Rainfall," "Rate of Increase of Underground Temperature downward," "Circulation of Underground Waters as related to the Water-Supply of certain Towns and Districts," and "Mathematical Tables." The reports on "Luminous Meteors" were particularly minute and exhaustive. They seem to have been intended to include as full and accurate accounts as it was possible to get of every meteor that fell anywhere on the earth within the view of a man intelligent enough to describe it; and they embody frequent suggestions as to the direction which future research might take. Thus, the report of 1874 noticed the apparent connection between some meteor-showers and certain comets, and spoke of the coincidences as being numerous enough and sufficiently exact to render desirable the further cultivation of cometary astronomy by star-shower observations. The report of 1875 pointed out that the work of properly treating meteor observations had become so great as to be beyond the power of the Association to grapple with it, and commended the arrangements which M. Leverrier was making for that study. In 1878 the committee, finding it probable that the highest attainable accuracy in mapping the observed directions of the apparent paths of shooting-stars was the real key to the solution of the problem presented by their nightly flights, and that the question of the possible connection of fire-balls and aërolites, or large stony masses, with such showers—and accordingly, it might be, in certain cases, with comets—depended for its solution on accurate observations of these meteors, recommended the study as an attractive one, and gave a series of directions for following it up.

A committee was appointed at the Aberdeen meeting of the British Association in 1859 to make observations, by means of a balloon, in the higher regions of the atmosphere. Nothing was done for two years, for want of a balloon and an observer. The committee was reappointed at the Manchester meeting in 1861; a balloon was contracted for with Mr. Coxwell, an expert aëronaut, and Mr. Glaisher, the most active member of the committee, volunteered to go up with him and make the observations. Twenty-eight ascents were made from Wolverhampton, the Crystal Palace, and other places not far from London, between the 17th of July, 1862, and the 26th of May, 1866, of which seven were made into extraordinarily high regions, from 22,884 feet to 37,000 feet, or seven miles. In all these ascents, Mr. Glaisher remarks, in the introduction to "Travels in the Air," "I used the balloon as I found it. The desire which influenced me was to ascend to the higher regions and travel by its means in furtherance of a better knowledge of atmospheric phenomena; neither its management nor its improvement formed a part of my plan."

The first ascent was marked by meeting a warm current at a great elevation. Clouds were entered at 4,000 feet, which proved to be also 4,000 feet thick. The temperature at starting being 59° Fahr., fell to 45° at 4,000 feet, and to 26° at 10,000 feet, from which it remained stationary up to 13,000 feet. Then it rose to 31° at 15,500 feet, and 42° at 19,500 feet, after which it fell rapidly to 16° at 26,000 feet.

In the ascent of September 1, 1862, the curious phenomenon was observed of the formation of clouds along the course of the Thames from the Nore to Richmond. The clouds followed the river in its course through all its windings, not departing from it on either side. It being about the time of high water, the formation was supposed to be the effect of the warm current coming up from the sea.

On the 5th of September, 1862, the aëronauts reached the height, which has never been surpassed by man, of 37,000 feet, or seven miles. Mr. Glaisher thus described his experiences after making his observations at 29,000 feet: "Shortly afterward, I laid my arm upon the table, possessed of its full vigor, and, on being desirous of using it, I found it powerless—it must have lost its power momentarily. I tried to move the other arm, and found it powerless also. I then tried to shake myself, and succeeded in shaking my body. I seemed to have no limbs. I then looked at the barometer, and while doing so my head fell over my left shoulder. I struggled and shook my body again, but could not move my arms. I got my head upright, but for an instant only, when it fell on my right shoulder, and then I fell backward, my back resting against the side of the car and my head on its edge; in this position my eyes were directed toward Mr. Coxwell in the ring. When I shook my body I seemed to have full power over the muscles of the back, and considerable power over those of the neck, but none over either my arms or my legs; now, in fact, I seemed to have none. As in the case of the arms, all muscular power was lost in an instant from my back and neck. I dimly saw Mr. Coxwell in the ring, and endeavored to speak, but could not; when, in an instant, intense black darkness came; the optic nerve finally lost power suddenly. I was still conscious, with as active a brain as at the present moment while writing this. I thought I had been seized with asphyxia, and that I should experience no more, as death would come unless we speedily descended; other thoughts were entering my mind, when I suddenly become unconscious as in going to sleep. I can not tell anything of the sense of hearing; the perfect stillness and silence of the regions six miles from the earth (and at this time we were between six and seven miles high) is such that no sound reaches the ear." During this time Mr. Coxwell was in the ring above the car, trying to open the valve. He also lost the use of his hands, and was obliged to seize the cord with his teeth and pull it by dipping his head. Consciousness returned gradually to Mr. Glaisher, and no inconvenience followed the insensibility; and when the party had landed, no conveyance being available, they were obliged to walk several miles.

In the ascent of June 26, 1863, the party passed through layer above layer of clouds to the height of four miles; in the descent, they passed through a fall of rain, and below it a snow-storm, the flakes of which were composed of spiculæ of ice and innumerable snow-crystals. On reaching the ground the atmosphere was thick, misty, and murky, and the afternoon cold, raw, and disagreeable for a summer's day.

The observations made during night ascensions, or those which were continued into the night, on temperatures at different heights, gave results different from the theories previously held on the subject. An increase of the temperature with the height was noticed after sunset. The rate of decline of temperature with elevation when near the earth was subject to variation as the sky was clear or cloudy. From an elevation of three miles cirrus clouds were seen apparently as far above the observers as they seem when viewed from the earth, and that under such conditions that it was hard to believe that their presence was due to moisture. The audibility of sounds from the earth depended considerably on the amount of moisture in the air. The noise of a railway train could be heard in clouds at four miles high, but not when the clouds were far below. The discharge of a gun was heard at 10,000 feet; the barking of a dog at two miles; but the shouting of a multitude at not more than 4,000 feet. Many differences in the results of observations were supposed to depend upon atmospheric conditions, while these vary with the time of day and the season of the year; so that a great many observations would be required to determine the true laws. Having followed up one of the observations recorded above with a captive balloon and by other means, Mr. Glaisher declared to the Meteorological Society, in 1870, that the theory that the temperature is always lower at higher elevations is not true.

Some noteworthy mental impressions are recorded in Mr. Glaisher's descriptions of his ascents. Writing of his feelings at the height of 23,000 feet, and under the imminent necessity of descending at once, he was surprised "at the extraordinary power which a situation like this calls forth, when it is felt that a few moments only can be devoted to noting down all appearances and all circumstances at these extreme positions; and if not so rapidly gleaned they are lost forever. In such situations every appearance of the most trivial kind is noticed: the eye seems to become keener, the brain more active, and every sense increased in power to meet the necessities of the case; and afterward, when time has elapsed, it is wonderful how distinctly at any moment scenes so witnessed can be recalled and made to reappear mentally in all their details so vividly that, had I the power of the painter, I could reproduce them visibly to the eye upon the canvas." A fine description, of which we can quote only a part, is given of the scenery of the upper air: "Above the clouds the balloon occupies the center of a vast, hollow sphere, the lower portion of which is generally cut off by a horizontal plane. This section is in appearance a vast continent, often without intervals or breaks, and separating us completely from the earth. No isolated clouds hover above this plane. We seem to be citizens of the sky, separated from the earth by a barrier which seems impassable. We are free from all apprehension such as may exist when nothing separates us from the earth. We can suppose the laws of gravitation are for a time suspended, and, in the upper world to which we seem now to belong, the silence and quiet are so intense that peace and calm seem to reign alone." The descriptions of sky and cloud scenes that follow are very picturesque.

Mr. Glaisher was elected a Fellow of the Royal Society in 1849. On the death of Lord Chief-Baron Sir F. Pollock, about 1870, he became the third President of the Photographic Society of Great Britain, an office which he still holds. This society presented to him in 1887 a marble bust of himself, executed under its direction by the sculptor Albert Toft. He was a juror in the class of scientific and philosophical instruments at the Great Exhibitions of 1851 and 1863, and was the reporter of the class in 1851.

Mr. Glaisher is the author of more than one hundred books and papers relating to astronomy, meteorology, and the theory of numbers. Some of these have already been mentioned. Among the others are many papers in the "Proceedings of the British Association" relating to his balloon ascensions and the subjects of his special investigations. His best-known work is "Travels in the Air," of which he is joint author, which is composed of the narratives by himself of his own balloon voyages and observations, and accounts by M. Gaston Tissandier and M. de Fonvielle of their experiments in the same line. He edited and compressed the English version of Camille Flammarion's "Atmosphere," performing, in addition to the regular labor of such a task, that of reducing the notations of the French system to their equivalents in English units, and replacing French observations and data with English corresponding ones. In 1877 he translated and edited Amedée Guillemin's "World of Comets." After he retired from the Royal Observatory he devoted himself to the completion of the factor tables, begun by Burckhardt in 1814 and continued by Dace in 1862–'65; Burckhardt published the first three millions, and Dace the seventh, eighth, and ninth millions. The three intervening millions have been calculated by Mr. Glaisher and published, with a full enumeration relating to the whole nine millions, in three quarto volumes. Since 1880 Mr. Glaisher has been chairman of the Executive Committee of the Palestine Exploration Fund.

CORRESPONDENCE.

GRANT ALLEN ON THE WOMAN QUESTION.

Editor Popular Science Monthly:

IT is gratifying to know that so able an advocate as Mr. Grant Allen has come forward to champion the cause of the real emancipation of woman, in claiming for her the right to be exempt from the burden of her own support. To meet with success as a bread-winner in these days of severe competition requires the best energies of the best years of life—just the time when a mother should be giving the best energies of life to the care of her children. The difference between a well-mothered child and an ill-mothered one, in morals, conduct, intelligence, and teachableness, is so great as to warrant the assertion that, next to heredity, a child's home training is the most important factor in the evolution of its character. Nature has ordained that for this training it shall look to the mother, and hence it is a self-evident fact that her own education should be such as will best fit her for the task. It is about what constitutes the proper training to this end that opinions differ. The average man thinks that to know how to make pies and sew on buttons is enough, while we "advanced" women believe that a "wise" and "sane" mother should be able to meet the moral and intellectual requirements of her children as well as administer to their physical wants. We believe that she should know enough of science to give reasonable answers to her children when they question her about the phenomena of nature, and not to object to the study of botany as improper for girls (which I heard a model mother of the good old school do, the other day) because it talks about the ovaries! We believe that her literary taste should be sufficiently cultivated for her to take pleasure in reading something above the inane fiction which constitutes the chief intellectual pabulum of the average woman of to-day; and even if she should have a taste for anything so dreadful as the higher mathematics, we see no great harm in her indulging it, if it gives her pleasure to do so; the worst that can possibly result being to give her children inherited aptitudes in the same direction. Indeed, we see no danger to the established order of the universe in her cultivating intellectual tastes simply for her own pleasure, if she chooses. It is only when a woman has to add the drudgery of bread-winning to the natural duties of her sex that she need be condemned to intellectual atrophy.

In dealing with this part of the subject, Mr. Grant Allen seems to have lost his usual clear-headedness when he mistakes the aim of "the woman's movement" for an "endeavor to put upon the shoulders of women, as a glory and a privilege, the burden of their own support." Now, I feel safe in affirming that there is not one among us, even of the most "advanced," who would not gladly welcome Mr. Allen's ideal civilization, in which all the labor should be done by men—and we won't even grudge them the cooking and the washing, which I can assure them is labor just as real as buying cotton futures or watering railroad stocks. The "woman's movement" does not aim to *force* upon women the burden of their own support, but merely to fit them, when that burden is forced upon them, to bear it successfully. Recognizing, as we do, the fact that, with our advancing civilization, a large and ever-increasing proportion of women must be self-supporting, we believe it is unjust and cruel that they should have to engage in the struggle handicapped by ignorance, hampered by conventional prejudices, and oppressed by political disabilities that deny us a vote even on the whisky question—a subject of such vital importance to us. In disposing of a large proportion of the 700,000 superfluous females of the United Kingdom as "infants, lunatics, sisters of charity, unfortunates, and ladies of eighty," Mr. Allen "explains" his statistics on one side only, and forgets to offset his incapables by at least an equal proportion of infants, lunatics, priests, octogenarians, convicts, drunkards, and other ineligibles of the opposite sex, to say nothing of that vast mass of incompetents who must rank away down below zero as husbands, and have to be supported by their wives or sisters. The existence of these negative quantities on the other side is one of the "deplorable accidents" that men are prone to overlook in considering this question, but it is one which enlarges so enormously the number of necessarily self-supporting women as to make it an open question whether they do not constitute a majority of the sex instead of a minority. Now, I am not arguing that this is right, but it is a deplorable fact all the same; and since we can not force the wicked men to support us, the bravest and strongest of us (instead of sitting down and crying about it) are claiming the modest right to at least support ourselves—and too often the men who ought to be supporting us into the bargain, or the children whose bread they are spending for whisky. And while we are thus relieving society of its "potential" paupers, can the witty philosopher think of no better return than to consign us, with a stroke of his graceful pen, to everlasting confusion as mere paltry accidents? Oh fie, Mr. Grant Allen!

One more word, as to the supposed effect of the higher education in deterring girls from marriage. I have been engaged in dispensing the higher education to girls for a good many years, and have yet to meet the first one who was the least averse to matrimony; on the contrary, to quote from a composition on "Girls," written by a little friend of mine not long ago, "I think it is the nature of girls to have sweethearts, whether they are little or whether they are big."

The only influence that education can have in "cornering" the matrimonial market is by making girls more fastidious, and this is not likely to have any practical effect except in the case of a few ugly girls. While I do not doubt that all women are just as willing to look pretty as they are to get married, the "factors of organic evolution," which have taken the place of our old-fashioned "providence," have not improved at all upon its methods, but have dealt so unfairly with a large proportion of the sex that, when told by Mr. Grant Allen that their first business is to look pretty, they feel very much as that philosopher probably does when blandly requested by the photographer to "assume a pleasant expression."

Now, as marriage means survival of the prettiest, rather than survival of the fittest (unless we take a purely masculine view of the case and assume that the prettiest *are* the fittest), all the matrimonial plums fall into the laps of the pretty girls, and the ugly ones have no chance at all but to take everybody's leavings. Of course, I know it is very unreasonable for an ugly girl to ask for any of the plums out of life's pudding; but then, women will be unreasonable, to the end of time—that is one of the factors of the woman question with which we shall always have to reckon. Moreover, the ugly girl sometimes has the presumption to be exceedingly clever, and feels that she can do much better for herself than marry a scrubby little clerk on forty dollars a month. Under the old *régime*, when marriage was the only possible solution for a woman of the problem of life, she had no choice but to take any man she could get; but now she naturally declines to give up a hundred-dollar salary for a fifty-dollar man. I do not pretend to decide the question whether the general good does not demand that she should still be forced to sacrifice herself in a distasteful marriage, rather than remain single to swell the number of "deplorable accidents" that so weigh upon Mr. Grant Allen's mind. From a human point of view it is undoubtedly for the general good that lobsters should be boiled, but we shall hardly get the lobster to look at it in that light.

E. F. ANDREWS.

WESLEYAN COLLEGE, MACON, GA.,
December 9, 1889.

DECADENCE OF FARMING IN ENGLAND.

Editor Popular Science Monthly:

I WAS very much interested in "The Decadence of Farming," which you published in November from the pen of Joel Benton. The picture which he draws of the destruction of the farming interest, both East and West, is a vivid one, and deserves the studied consideration of economists. I do not now say that the statements of facts are overdrawn, that the conclusions drawn are illogical and strained, nor that the condition of affairs, as depicted, can be logically and naturally explained in antagonism to Mr. Benton's conclusions; nor do I stop to point out, now, the facts which his article contains, which, if reasonably interpreted, will nullify his conclusions. My purpose in this letter is to present another picture, not so artistically drawn, it may be, but as true to life, I think, as Mr. Benton's picture.

The daily papers of November 30, 1878, contained a news-telegram from London, dated the 29th. After noticing the condition of trade, the closing of factories, and the reduction of wages, it continued: "Kentish hop-growers say, 'As the general depression of agriculture and commerce is largely caused by the protective tariffs of other countries, the duties on foreign productions should be revived.'"

I do not know the political views of the reporter of that dispatch; but the Associated Press reports are presumed to be non-partisan.

The New York correspondent of the Cincinnati "Enquirer," under date of December 12, 1878, sends to his paper the report of an interview with Mr. Armour, the noted dealer and packer of meats, of Chicago, who had just returned from an extended tour in Great Britain. In the reported interview Mr. Armour said: "The manufacturers are running behind, the tenants can not pay their rents, real estate has shrunk in value and can not be sold at any price. . . . The shrinkage is awful. . . . The hard times," he said, "will end in a dreadful depreciation of real estate."

I do not know the politics of Mr. Armour; the "Enquirer" represents the theory of "free trade."

The Chicago "Tribune" of July 8, 1879, reprinted from the New York "Herald" an editorial in regard to English affairs, in which the "Herald" said, "The agricultural depression in Great Britain has been felt for a long time very severely by the tenant farmers." The "Herald" then quoted from the "Pall Mall Gazette" that "the prevalent belief as to the severity of the depression existing in English agriculture will be confirmed by figures recently produced before the Devizes Union Assessment Committee."

The three papers mentioned in this paragraph represent free-trade ideas.

The London "Telegraph," of March 26, 1881, as cited by several American journals, said that, according to a correspondent of a provincial contemporary, "the depression in the agricultural districts is fully as great as it was represented by many of the speakers in the debate in the House of Commons on Wednesday. . . . Thousands of acres," it said, "are lying unproductive, because without tenants, in various parts of England; and a clergyman, writing from Nottinghamshire, gives a doleful account of affairs in that district. There seems, he says, to be a better state of things in towns than in the country. Here general bankruptcy seems imminent. Hundreds of farms are to be let and few farmers seem to have any capital left to take them." No reform of more urgent interest could possibly be taken in hand by any ministry than the raising of British agriculture from its present drooping condition.

Under date of January 10, 1881, consular clerk Charles F. Thirion, of Liverpool, reported to the State Department some facts concerning English agriculture. The comparisons, when not stated otherwise, are between 1870 and 1879. The report shows a decrease of arable area, 3·3 per cent; of corn land, 3·1 per cent; of wheat land, 16·3 per cent; of barley land, 13·8 per cent; of oat land, 4·4 per cent; a comparison of 1879 with 1874 shows a decrease in the number of sheep of 1,414,000, a little more than 7 per cent.

The Chicago "Tribune" of June 21, 1881, reprinted from the New York "Tribune" an article upon English estates. In that article the "Saturday Review" is quoted as saying, "A state of things has undoubtedly existed for some time, and still exists, which justly awakens great anxiety for the future of the country, and profound sympathy for the sufferers. . . . The advertisements in the London 'Times' bear eloquent testimony to this state of things. Columns are filled with notices of old country residences, broad demesnes, wooded parks, and snug country-houses to be sold. . . . Ninety-five per cent of the small estates are mortgaged, often for one third or two thirds of their value."

The New York "Tribune" represents protective ideas the other two papers are free-traders.

A telegram from Washington to the St. Louis "Globe-Democrat," dated August 7, 1882, stated that a communication had been received at the State Department from the consul at Liége. As reported by the telegram, that communication contained this summary: "In one year, the falling off in English agriculture was 42 per cent; for six consecutive years it was 20 per cent."

The "Globe-Democrat" is recognized as a protective organ of a very conservative type.

The Chicago "Inter-Ocean" (protection) of September 27, 1889, reprints this excerpt from the London "World": "An example of the ruinous depreciation of agricultural land in Lincolnshire was recently afforded when a farm with houses and buildings, in the neighborhood of Alford, was offered for sale, and the highest bid was £2,100, although the property cost £6,700 eighteen years ago, and a considerable sum has since been expended in improvements." The same Chicago journal quotes from the London "Times" that "fifty per cent of the dock laborers, including perhaps the permanent men, are agricultural laborers in point of origin."

The startling likeness of the two pictures must be remarked. The one is fuller, decked off with more rhetoric, than the other, but the essential features are the same: the heavy mortgages; the depreciation in value to one third of the cost; laborers abandoning the farms for town and city; the abandoned (at least uncultivated) lands; unprofitable farming; decrease in productions and of sheep. I have given the character of my witnesses, when known. If Mr. Benton had admitted that his principal witness on the wool question, Hon. John E. Russell, was a free-trader and interested in free wool (which I understand to be facts), the value of his "opinion" would be heavily discounted. The pertinent question that must arise here is, If the protective tariff of the United States has destroyed the agricultural interests of this nation, did the free-trade policy of Great Britain cause the great depression in the agriculture of that nation? In other words, does agriculture prosper any more under free trade than under protection?

M. B. C. TRUE.

EDGAR, NEB., *December* 7, 1889.

THE TEST OF INSANITY.

Editor Popular Science Monthly:

SOME parts of the paper by Dr. Sir James Crichton-Browne, in the November number of your journal, are open to serious criticism. I refer especially to his remarks "on the insufficiency of the definition or test of insanity laid down by British and American courts, and on an amended test which would commend itself to medical experience."

It is admitted by the learned writer that the accepted legal test—a knowledge of right and wrong in reference to the criminal act—is satisfactory in most cases; but he holds that there are certain morbid states of the emotions and will which constitute insanity, although connected with a sound intellect. Now, the vast majority of medical men with experience of the insane have no knowledge of such cases. For myself, I have never seen a case of this kind in the examination of several thousand lunatics, and I have never heard of any mark by which these can be distinguished from cases of vice and crime. Dr. Crichton-Browne commends the test of Lord Bramwell, contained in the questions: "Could he help it? Was the lunatic free to choose, or under the duress of disease?" And there is no doubt that the power of self-control is an essential element in the question of responsibility. We may even admit that "impairment of will or loss of self-control, more or less pronounced, is the first, last, and universal element in insanity." But impairment of will is found in all human beings, the sane and the insane. A heathen poet has confessed: "*Video meliora proboque, deteriora sequor.*" [I perceive the better things, and approve them; I follow the worse.] And a sacred writer declares: "The good that I would, I do not; but the evil which I would not, that I do." Loss of self-control, then, is not at all peculiar to insanity, and the degree of this loss has no measure in medical science. Plainly, the proposed test is quite without value, and, indeed, is no test at all.

Again, it is proposed to make "a condition of insanity" the test of responsibility. But the term insanity is so extremely vague and indefinite, even as used by medical men and experts, that it is worthless for such a purpose. It is applied to every kind and degree of chronic mental disorder, without reference to the element of responsibility. About fifty years ago a law was enacted by the Legislature of New York in these words: "No act done by a person in a state of insanity can be punished as an offense." But Chief-Judge Beardsley (in the Freeman case, 4 Denio, p. 27) held that the natural construction of this act "would indeed be a mighty change in the law, and afford absolute impunity to every person in an insane state." He refused, therefore, so to construe it, and held to the principle of the English law, which has ever since been adhered to by our courts.

It is plain, indeed, that insanity may exist in a degree calling for medical treatment, and even for confinement in an asylum, without bringing with it irresponsibility for crime. In the case of Speirs, a patient set fire to the Utica Asylum to revenge a wrong done him by the authorities. The act was found to be a sane one, and the lunatic was sentenced to a long term in the State prison. It is safe to say that in most asylums there will be found at least ten per cent whose degree of insanity is less than that of the notorious Guiteau. But the jury were able, under the common-law test, to find that Guiteau's motive was a vicious one, and that he had the power to refrain from his crime.

So indefinite, however, is the line between sanity and insanity, and so hard to be drawn in cases made still more difficult by passion and prejudice, that the plan of a permanent commission, of lawyers and physicians, to visit those who have escaped punishment on the ground of insanity, and report, from time to time, on their condition, should be commended to our Legislature. In this way, perhaps, some light may be thrown on the question of a legal test of insanity, and upon the true value of expert evidence. At present, in view of the law which forbids a physician to disclose on the witness-stand any information acquired by him in a professional capacity, thus often withholding facts of the utmost importance, the necessity of expert testimony in lunacy cases must be admitted. It remains, however, to define more exactly who are experts, by whom they shall be called, and what questions they shall answer. Upon these points, also, the suggestions of Dr. Crichton-Browne are most practical and valuable.

L. A. Tourtellot, M. D.

Utica, N. Y., *November* 30, 1889.

EDITOR'S TABLE.

USEFUL IGNORANCE.

MR. HERBERT SPENCER, in a well-known essay, has discussed the question, "What knowledge is of most worth?" It is perhaps time to begin the discussion of the question, "What ignorance is of most value?" There is a story told of the great philosopher whom we have just named that, on one occasion, in reply to a question upon some rather minute point of history or archæology, he expressed a devout thankfulness that he knew nothing whatever about it. The capacity of even the greatest minds is limited; and the man who would make the best use of his powers of memory must exercise a wise discretion as to the things he undertakes or tries to remember.

If any principle in education ought to be clear, it is that there should be no overcrowding in the mind of the pupil, but that each portion of knowledge imparted should have room to define itself, to assume distinctness and to grow. Where there is overcrowding there will be no sense of order and no healthy development of ideas. All educators acknowledge this, just as men in general acknowledge the moral law; but how many of them live up to it? How many of them are willing to leave in their pupils' minds liberal tracts of ignorance, acknowledged as such—tracts which might be cultivated, but which are left fallow simply in order that the mental powers may not be overtaxed nor imagination unduly restrained? We venture to say that the cases are rare in which an effort is not being made to cultivate, as it were, every square inch of mental territory, and call all the strength of the intellect into exercise. Each school or academy must teach so many "branches"; it would never do for one to omit what another has in its curriculum; and every pupil, if not compelled, is urged to take up just as many subjects as he or she can possibly grapple with. The general, at least the frequent, consequence is — congestion, confusion, enfeebled memory, impaired judgment, lowered intellectual vitality. Better far, in many cases, would it have been if the child, with no education beyond reading and writing, had lived in a concrete world and picked up, gradually, verifiable notions about real things. There is nothing fortuitous in the fact that so many men, eminent in various departments of life, have had but the most meager "educational advantages" in their youth. It would seem as if the one great "educational advantage" they had was in getting free from so-called education at a very early period and betaking themselves to the school of active life—a school that leads up to abstract truths only through multiplied concrete examples; that leaves ample space in the mind for useful ignorance, and consequently makes all the better provision for useful knowledge.

There is much sound philosophy in regard to education abroad in the world to-day. What is needed is, that educators should be as wise in practice as they are in theory. The labor of the gardener, every one knows, consists, to a large extent, in "thinning out" his crops. If a similar process could be practiced on the minds of the young, and if it were practiced, the evils of too copious sowing would not be so great; but, as the method is hardly applicable to intellectual growths, teachers should educate themselves up to the point of sowing sparingly in order that they may reap abundantly. The evil of too thick sowing attains, we believe, greater proportions in academies for young ladies than anywhere else. There, nearly everything that is taught to boys enters into the course of instruction, while music and other "accomplishments," together with an extra language or two, are generally superadded. As if this were not enough, a special acquaintance with the literature, history, and institutions of the ancient Jews, untinged, however, by any touch of "modern criticism," is frequently also insisted on. The effect of all this may be easily imagined—a spindly growth of rootless ideas, habits of intellectual indifference, a medley of incongruous notions in regard to ill-apprehended facts; in a word, a seriously injured, if not a fatally ruined, intelligence.

The intellectual signs of the times, it should be remembered, are not all favorable. We have such an educational apparatus, for extent and scope at least, as the world never saw before; but the results—it is not easy to be enthusiastic over the results. Where is the quickened sense for evidence that we might have expected to see? Where the seriousness of intellectual aim? Where the refinement of popular taste? Cant seems to stalk abroad through the world as potent an enslaver as ever of the minds of men. Credulity is wide-spread. Superstition still occupies its strongholds and rules over vast multitudes. Faction controls our politics and legislation is made a plaything. We have, perhaps, expected too much of education in the past; but at least, if we arderstand its true principles, we should try to apply them. One of the first of these principles is not to teach too much, not to congest the mind, not to overtax its powers. Our effort should be to whet curiosity, awaken a certain variety of interests, develop the natural powers of the mind, and leave room for the imagination to work. It is the spontaneous effort of the mind, not its forced labor, that yields the best results. Hitherto we have been fighting ignorance so hard, and have been so afraid of it, that the idea of knowledge in any degree being dangerous has seldom occurred to us. But knowledge may be as dangerous as food, if given in wrong quantities and under wrong conditions. When we realize this as fully as we have heretofore realized the danger of ignorance, a new era in education will have dawned.

INDIVIDUALISM.

The discussion on the land question in the London "Times," a further installment of which is given in our present issue, will have, we may hope, one or two good results. It will tend to produce in the public mind a more vivid sense of the difficulty of dealing with the land question on any abstract principles, and it will help, perhaps, to bring home the lesson that social progress is more a matter of individual improvement than of political reconstruction. Mr. Auberon Herbert, in the letter which we print this month, calls attention to the fact that the whole drift of Mr. Spencer's philosophy is toward individualism, and suggests that the social dangers of the present time arise precisely from the fatal disposition of men to invoke state action as a remedy for all evils. It is indeed a serious fact that so few of those who seek to catch the public ear lay any emphasis on the need for individual reform, or have anything to say about individual responsibility. Institutions are wrong, laws are wrong, social organization is wrong—all general forces and agencies are wrong; but rarely does any one discover that this or that man is wrong. Such a discovery, if made, would perhaps not be thought worth announcing, or perhaps might not be considered safe to announce. It is more popular to abuse institutions at large than to attempt to fix the responsibility for their defects; and no prudent orator would think of suggesting to his audience that the true starting-point of reform would be in the habits and dispositions of just such people as themselves.

Mr. Frederick Greenwood's letter, published by us last month, furnishes a striking illustration of the readiness with which the principle of personal responsibility is overlooked by even thoughtful writers. Mr. Greenwood reads a lesson to Mr. Spencer for having, as he considers, put forward certain radical theories as to land tenure without sufficient qualification, and so given occasion to men like Mr. Laidler to quote him in support of their revolutionary schemes. The true view of the matter, however, is that Mr. Spencer acquitted himself of his duty to society by giving expression to the opinions which, at the time, commended themselves to his acceptance. He did not force them upon the world, or upon any one. He did not offer them as infallibly inspired; he gave them simply as the views of Herbert Spencer, guaranteeing nothing, even by implication, save their sincerity. What was the nature, then, of his responsibility in the matter? We answer that he staked, to a certain extent, such literary or philosophical reputation as he had, at the time, acquired, and made himself a mark for the criticism of all who differed from him in opinion. On the other hand, he did *not* render himself responsible for all who might adopt his views simply because they were his, or for those who, under any circumstances, accepted them without sufficient examination, possibly without possessing the qualifications necessary for giving them any examination deserving of the name. Nor did he make himself responsible for the inertness of those who, having examined the views in question and found them unsound, failed to demonstrate the fact to Mr. Spencer himself or to the public. When thirty valuable years, in which certain (let us assume) erroneous speculations might have been combated, have been allowed to slip by unimproved, so far as that object is concerned, it seems late in the day to turn round on the author of the speculations and read him a lesson on the responsibilities of a philosopher. The true way in which to have enforced his responsibility was to criticise his views with the utmost rigor, misrepresenting nothing, but omitting no argument that may fairly tell against them. It should not be forgotten, however, that Mr. Spencer showed a further sense of responsibility in withdrawing from circulation the book in which his speculations on the land question were contained, as soon as he became convinced that the views enunciated by him upon that point and upon one or two others discussed in the same volume needed amendment or qualification, and in giving it to be distinctly understood that he no longer held to his former opinions on these matters. It is hard to understand, therefore, how the principle of personal responsibility could have been more fully recognized, or the duties flowing therefrom more scrupulously performed, than they were in this particular case by the eminent author of the "Synthetic Philosophy."

More to the purpose would it have been, in our opinion, had Mr. Greenwood dwelt with some force on the responsibility—too little recognized—which rests upon those who pin their faith to the authority of others. This is a thing which is too often done in a most reckless and irresponsible manner, with the result of rendering public opinion far less intelligent than it ought to be and might be. A sense of individual responsibility for opinions accepted would lead to a more careful examination of all theories and reasonings; and would, in a multitude of cases, abate the blind confidence with which ill-understood notions are now espoused. It is quite true that every one is not able to subject the views of a writer like Mr. Spencer to critical scrutiny; but those who can not do it should, at least, try to take the right measure of their own powers, and abstain from judgments for which they can not give adequate reasons. Very serious also is the responsibility resting upon those who recognize that an opinion which has been given to the world is erroneous. The duty of such persons is to proclaim what they hold to be the truth according to the measure of their opportunities and the urgency of the occasion. Because A has accidentally kindled a conflagration, shall B, who is passing by, and who has water at command, make no effort to arrest the flames? Upon whom, in such a case, does the heavier blame rest—upon the man who, without intending it, has set things on fire, or the man who, rather than take a little trouble, lets the fire gain headway? The doctrine of individual responsibility is the true leaven that will leaven society; for it comes home to each man and summons him to put the question seriously to himself whether he is making the most and the best of his own powers, whether he is really striving to be an efficient unit in the social body. Thousands, nay millions, to-day are waiting for some supernatural or revolutionary moving of the waters, in order that they may, in a moment, be healed of their infirmities. The doctrine of individualism bids them halt no longer by the pool, but go straightway about their business in a new spirit of duty and self-help.

We are glad to welcome the appearance of a book which promises to help in this direction, namely, Mr. Wordsworth Donisthorpe's "Individualism [illegible]

System of Politics"—a book which ably vindicates the sufficiency of individual initiative in a vast number of matters that have been laid hold of by the state. The present mania for legislation Mr. Donisthorpe attributes to the inexperience and want of historical knowledge of the classes who now control the suffrage. Errors which the more thoughtful and instructed members of the community have outgrown still look like truths to the less thoughtful and less instructed. The watchword of the hour is individualism, which simply means personal liberty and personal efficiency carried to their highest point. Let all who believe in this do their utmost to make the truth prevail.

LITERARY NOTICES.

Christian Theism: Its Claims and Sanctions. By D. B. Purinton, LL. D. New York and London: G. P. Putnam's Sons. Pp. 303. Price, $1.75.

The author of this book, who is Professor of Metaphysics in West Virginia University, in presenting his thesis, has had three objects in view, viz.—to construct a progressive argument logical in its method and correct in its general conclusions, and likewise defensible in each individual part and item of it; to free the subject from ordinary obscurities and difficulties; and to present it, "without dodging any of its profound problems," in such a clear and simple manner as to commend it to the general reader who is willing to think as he reads. Christian theism being presented as a fact, making positive, bold, radical, uncompromising, and universal claims, the author presents as arguments in support of it: Intelligence in nature, the eutaxiological argument; volition in nature, the teleological argument; the personality of God, or the intuitive argument; the goodness of God, or the historical argument; the unity of God, or the monistic argument; and the infinity of God, or the causal argument. As "antitheistic errors" are combated materialism, pantheism, positivism, and agnosticism. The last system is regarded as "an ingenious combination and modification" of the other three systems, which in its present phase has taken shape and name from Herbert Spencer, "the great agnostic of modern times," a study of whose works "produces a profound conviction of his depth and patience of thought, his breadth and profundity of scholarship, his fertility of imagination, and his frankness and earnestness of purpose." This system is reviewed in an attempt to show it to be logically self-destructive. A comparison of "Evolution and Christian Theism" leads to the conclusion that most of the objections to the former scheme lie not so much against evolution as against the mechanical form of it. "Nature is not a machine, for it is plastic, progressive, improvable, while a machine is neither of these. Matter can reveal higher and still higher forms of organism, but can never create them. Matter, motion, and force, without a directive idea, can do nothing toward explaining a rationally developed universe. But why exclude a creative and directive idea? Let that idea be God. There is not a single fact in nature against the existence of a personal God or the occurrence of an act of creation. There are many facts in favor of both. Why not admit that God made the world and sustains it in being? That admission would not blot out evolution, but would view it as a possible or it may be probable method of God's creative and providential work." The question would then be not "evolution *versus* creation," but "evolution the method of creation." The question of immortality is also considered.

The Land and the Community. By S. W. Thackeray. New York: D. Appleton & Co. Pp. 223. Price, $1.

This work bears the indorsement of Henry George, who supplies it with a preface. In its original form it was presented as a thesis to the University of Cambridge for the degree of Doctor of Laws. The essay has been expanded and arranged for reference. It is commended for the fullness and clearness with which the historical and legal aspects of the question have been dwelt upon, the attention given in it to the matter of compensation, and the religious feeling and conservative disposition manifested in it throughout. It serves the office, according to Mr. George, of a clear and simple exposition of essential principles and important facts, which shall give force and definiteness to the ideas growing out of the doctrine of equality of right to the use of the land, make manifest their conformity with historical experience and religious truth, put them in such a relation that the recognition of common rights in land may strengthen, not weaken, the recognition of individual rights in the products of labor; and supply answers to the arguments urged upon the other side. Mr. Thackeray begins his thesis with a history of land tenure in England, divided into the pre-feudal, feudal, and post-feudal periods, in which the subject is treated with special reference to the rights and interests of the community as distinct from the individual interests involved. The origin of the present system is traced to the acts of 1656 and 1660, "which turned military tenures into free and common socage." Community rights were trampled upon or ignored under these acts, the custom of making settlements grew up and was recognized, and lands before common were inclosed without effective resistance till about half a century ago, when laws were passed restricting the right. The key to the future of land tenure may be found in the exercise of the right of eminent domain, which the author regards as an assertion of the state's ownership and its right to change tenants on condition of the new tenant indemnifying the old one for the damage he may suffer. The right of the community to resume its possession of the land being, as the author believes, shown, a second part of the work is occupied with the questions relating to compensation. The rights of the community may be reasserted and secured by requiring those who occupy or cultivate the land to pay to the community a full equivalent for the special privileges which they thus enjoy—that is, through the appropriation of ground-rents by taxation, and applying the proceeds for the benefit of the whole community. A plan is outlined for effecting the change with the least harshness; and the beneficial effects anticipated from it are enumerated. As to those who may be supposed to be injured by the change—reduced to landlords—the conclusion is reached that most landlords would lose nothing without receiving advantages nearly if not fully compensating them; while the others, if not relatively as great gainers as other classes of the community, would not be absolute losers. The landlords' claims for compensation are examined and found not good, either in law or equity—in fact, the claim of the community against them is assumed to be the better one; and, finally, they are invited manfully to accept the situation, and themselves lead in recognizing the justice of the new dispensation.

Studies in Pedagogy. By Thomas J. Morgan. Boston: Silver, Burdett & Co. Pp. 355. Price, $1.75.

The author, Principal of the Rhode Island State Normal School, and before that of normal schools at Potsdam, N. Y., and Peru, Neb., has embodied in this volume the fruits of many years of observation, reading, thinking, and experience in the exercise of his profession, and makes in offering them "an earnest effort to contribute toward the promotion of higher ideals of education and better methods of teaching." His view of education in the general sense is a broad one, and embraces all that marks the difference between what a child is by nature at birth and that which he becomes by growth, training, and experience. In this sense, nature is embraced as one of the greatest forces of education. In the narrower sense, to the consideration of which this book is chiefly devoted, education is restricted to the effect produced upon the young mind by those who seek purposely to influence it, or the direct influence of teachers and schools. Its most important factor is training, which here signifies such a control exercised by the teacher over the pupil as will lead him so to use his faculties as to secure their completest development; and which has for its immediate end the evolution of power. These faculties may be grouped under the heads of acquiring, understanding, reproducing, using, and expressing knowledge, each of which, again, includes its own several topics and means. More nearly than any other work of the teacher it meets the ideal of education; it is an essential preliminary to a successful work of instruction; and is the process that best prepares the student for the active duties of life. The special applications of training discussed are those to the senses, the imagination, thinking, the sensibilities, language, the will, learning music, the use of books, and "training for freedom." There must be method in the performance of the teacher's work; hence we have a series of chapters on "Methodology." In "Man and his Method" the principle is enforced that, important as the method may be, the man behind it, who should inspire it, is more so. Method in questioning and in teaching arithmetic is treated with some fullness. The value and purpose of examinations are estimated. "The Ideal Schoolmaster" holds up the objective toward which every teacher should strive. "The True Function of a Normal School" is a paper which was awarded the prize of the American Institute of Instruction in 1885. "Advice to Young Teachers" embodies the substance of several addresses to graduating classes of the normal school. In them "Independent Thinking" and "Training for Citizenship" are prominent topics.

Geology of the Quicksilver Deposits of the Pacific Slope, with an Atlas. By George F. Becker. Washington: Government Printing-Office (United States Geological Survey). Pp. 486, with seven Plates. Atlas, 14 sheets. Price, $2.

The field work of the investigations recorded in this volume occupied the most of three seasons, beginning in 1883. There remained to complete the examinations satisfactorily the investigation of some important general problems affecting the whole region. Among these were indications afforded by the paleontology and structure of a previously undetermined non-conformity existing in the Coast Ranges. These were confirmed. Another investigation related to a possible connection between the formation of ore deposits and the metamorphism of the Mesozoic rocks. A third special inquiry was directed to determining whether the deposition of cinnabar is still taking place at Sulphur Bank and Steamboat Springs, and, if so, under what conditions the solution and precipitation of cinnabar and the accompanying mineral occur. The author finds that the quicksilver deposits lie along the great axes of disturbance of the world. One of these is on the line of the principal mountain systems of Europe and Asia, and the other coincides with the western ranges of the Cordilleran system of America. The principal mines are at Almaden in Spain, Idria in Austria, Huancavelica in Peru, and those in California. From 1850 to 1886 California supplied nearly half the product of the world, but is not probably destined to maintain the same rank in the future. Quicksilver was first recognized as occurring at the croppings of the new Almaden mine in 1845. But few other minerals occur in considerable quantities with the ore. Among them are pyrite or marcasite, arsenic and antimony, and sometimes copper ores, while other metalliferous minerals are comparatively rare. The principal gangue seems to be silica or carbonates. The cinnabar appears to have been deposited solely in pre-existing openings, and never by substitution for rock. The fissure systems, which are always present, are very irregular, and deposits can not conveniently be classified according to existing systems. All of them seem to have probably been deposited in the same way from hot sulphur springs. At Sulphur Bank cinnabar is now being precipitated from heated waters largely by the action of ammonia; at Steamboat Springs it is being deposited without complications from the presence of ammonia. In dealing with the processes by which the ore has been dissolved and precipitated in nature, it has been shown by experiment and analysis that cinnabar unites with sodium sulphide in various proportions, forming soluble double sulphides, and that these compounds can exist in such waters as flow from Sulphur Bank and Steamboat Springs, either at ordinary temperatures or above the boiling-point. The quicksilver is probably derived from granitic rocks by the action of heated sulphur waters, which rise through the granite from the foci of volcanic activity below that rock.

Coal and the Coal Mines. By Homer Greene. Boston and New York: Houghton, Mifflin & Co. Pp. 246. Price, 75 cents.

This is a volume of the attractive "Riverside Library for Young People," and is intended to tell readers, in a style free from minute details and technicalities, all that relates to coal and to procuring it from the earth. The information has been gained for the most part, the author says, from personal experience in the mines; but little of it comes from books, for the literature of the special subject is meager. Beginning at the beginning, we have a brief reference to the geological record previous to coal. Then the composition of coal is elucidated, the time when it was formed is defined, and the situation of the coal-beds is described. The history as it relates to our own period begins with the discovery of coal and its introduction into use. The account of the mines includes the way into them, the plan of a typical mine, "the miner at work," the obstacles and dangers he has to encounter, and the anthracite breakers. A chapter is given to the bituminous coal mines. The account of "The Boy Workers at the Mines" is of particular interest to the young people, and the chapter on "Miners and their Wages" to searchers for facts.

A Handbook of Obstetrical Nursing. By Anna M. Fullerton, M. D. Philadelphia: P. Blakiston, Son & Co. Pp. 214. Price, $1.25.

The great number and variety of the things to be attended to in a case of childbirth, many of which are not so familiar as the matters concerned in the treatment of disease, together with their importance as affecting two lives, make a special manual on this subject highly desirable for the nurse. It would be well, also, for every mother to have read a book of this sort before her confinement, in order that she may understand and co-operate in the efforts of the physician and nurse for her welfare, and be protected from the antiquated wisdom and dismal tales of injudicious friends. It would be difficult to make a more comprehensive and practical book than Dr. Fullerton's. It is an outgrowth of the extensive practice of the hospital and the systematic instruction of the nurses' training-school. The teachings which it embodies are chiefly the substance of a series of lectures delivered yearly by Dr. Anna E. Broomall to the nurse-pupils of the Woman's Hospital of Philadelphia, and they are followed in the Maternity connected with that hospital. The whole ground from the management of pregnancy to the ailments of early infancy is covered. Directions, sufficiently detailed for the use of a trained nurse, are given for the care of the patient immediately before and during labor, for the care of the new-born infant, and the management of the lying-in. The appliances which the nurse will need to use, and the articles of clothing for mother and child, are described, and many of them are figured. The Jenness-Miller reformed garments are indorsed. A short chapter is devoted to the appearance of infants in health and disease. In the chapter on ailments of infancy the *couveuse*, or brooder, for keeping premature infants warm, is described and figured. Throughout the volume reference is made easy by printing the subject of each paragraph in the margin.

Fossil Fishes and Fossil Plants of the Triassic Rocks of New Jersey and the Connecticut Valley. By John S. Newberry. Washington: Government Printing-Office (United States Geological Survey). Pp. 152, with 26 Plates. Price, $1.

The Triassic rocks, according to Prof. Newberry, probably furnished the first fossils collected on this continent: fishes at Durham and Sunderland, Conn.; plants at Richmond, Va.; and the so-called bird-tracks at Turner's Falls, Mass. While the formation has received considerable attention in detail, no systematic collection or thorough study of its fauna or flora as a whole was attempted till about 1880, when Prof. Fontaine took it up for the fossil plants of the Virginia and North Carolina Mesozoic coal basins. His publication established the parallelism of our new red sandstone with the keuper of Europe. The animal remains were left to be studied, and that work was taken up by Prof. Newberry, with results that are presented in this volume. The special studies are preceded by a geological sketch of the new red sandstone regions of New Jersey and Connecticut, concerning the relations of which to one another there appear to be different opinions. The Triassic rocks are about five thousand feet thick and present some singularities of structure. The materials were probably derived from the adjacent highlands. The rocks are characterized by their red color, derived from the oxide of iron, the presence of which proves that they contained but little organic matter when deposited. Their relations to the Triassic beds of the interior and the western margin of the continent can hardly be established without larger collections of fossils from Western localities. The fishes, though so far as yet known representing only six genera and about twenty-five species, are locally very numerous, and are found in many places. The principal sites represented in the volume are Boonton, N. J.; Durham, Conn.; and Turner's Falls, Mass.; while they have also been obtained at Plainfield, Milford, Newark, and near Hoboken, N. J., and at Middletown, Sudbury, Chicopee, Amherst, and Hadley's Falls, in the Connecticut Valley. The several species are described in detail and illustrated by figures apparently of the size of nature. We are glad to learn that the author's collection, which is the largest yet made, is safely deposited in the fire-proof Geological Museum of Columbia College.

LIGEROS APUNTES SOBRE EL CLIMA DE LA REPÚBLICA ARGENTINA. (Notes on the Climate of the Argentine Republic.) By GUALTERIO G. DAVIS, Director of the Argentine Meteorological Office, Buenos Ayres. Pp. 254, with 27 Plates and Charts.

THE Argentine Meteorological Office was established in 1872, and was organized under the direction of Dr. B. A. Gould, whom Mr. Davis succeeded on his retirement after twelve years of service. It has gradually extended its sphere of operations to the most remote parts of the country, and now receives observations of the more important weather phenomena from sixty-six stations, and of rainfall from ninety more. The six volumes of the publications of the office embody the results of observations taken at twenty-six points, with analytical discussions of the data, and deductions of the general laws of atmospheric changes; and the annual reports contain a large part of the results reached in the corresponding years. But a more compact work was needed to embody a summary of these results adapted to practical use; and the attempt is made to supply this need in the present volume, which is intended to put within reach of the colonist, the farmer, and the doctor such meteorological facts as bear upon their industrial enterprises and hygienic studies. Twenty-one stations are selected as typical of the various climatological conditions that prevail in all parts of the republic. The lines extend from the Atlantic coast to the western points of the country, and from latitude 54° 53′ in Tierra del Fuego to Salta in latitude 26° 46′ 20″; the altitudes range from 8 metres to 2,845 metres above the level of the sea. To each of these stations is allotted its given space for general description, with tables representing the various meteorological facts in detail and a graphic chart. The publication thus furnishes a summary of the local climates, deduced from several years' observations of the various districts of which the particular stations are the centers.

MONOPOLIES AND THE PEOPLE. By CHARLES W. BAKER, C. E. New York: G. P. Putnam's Sons. Pp. 263. Price, $1.25.

THERE is abundant reason for including monopoly among the "Questions of the Day," as is done in this volume. Trusts and monopolies exist, as the author shows at length in a series of chapters, in manufacturing, mining, transportation, trade, and labor. There are monopolies constructed directly by those who profit from them, monopolies created by municipal enactments, and monopolies supported by governmental policy. The author next examines the theory of universal competition, after which he states the laws of modern competition. He denies that "the prevalence of monopolies evidences the decay of the nobler aspirations of humanity." He regards them as an outgrowth of the modern conditions of industry, and, while they involve evils, he affirms that "the remedy for the evils of monopoly is not abolition, but control." He then specifies some of these evils, and names also some ameliorating influences. The remedies that have been proposed are based on one or the other of the opposite principles, individualism and societism, or communism. Mr. Baker maintains that neither should be adopted wholly, and in his concluding chapter advocates the owning of all railroads by the Government, and their operation by corporations which should pay a rental for the privilege; the owning of mines by the States, which should lease them to private parties for operation. Water-works, gas and electric lighting plants, street railways, and similar local enterprises should be owned by the cities in which they are located, and also operated by private companies. Mr. Baker does not favor the same procedure in the case of monopolies in trade and manufacturing. But he would legalize them, and then force them to let daylight in upon their operations and agreements, and apply to them the principle of non-discrimination.

Aryan Sun-Myths the Origin of Religions (Nims & Knight) is the title of a book designed to show that the mythology of this great primitive race is the parent of the chief modern religions, just as the race itself is the parent of the peoples who hold these religions. In the Aryan mythology we have the immaculate conception, from which the son of heaven, the sun, is born, at the time of the December solstice. We have the twelve signs of the zodiac as his disciples; his temptation, persecution, and execution. There is a descent of the sun into hades, when he enters the sign Capricornus and appears to remain three days at his lowest point. The Aryans observed baptism, sacrifice, and the eucharist, and the doctrines of original sin and the fallen condition of man were not unknown to them. When we come down to the Hindus, who have written religious records, we find the same features and more. So also among the Persians, the Egyptians, the Chinese, the Greeks, the Scandinavians, and the ancient Mexicans. Some of the same ideas are found among other ancient nations of the Old World, and among the American Indians. "Ancestral and other systems of worship," says Mr. Charles Morris, in the introduction which he contributes to the volume, "have influenced religious practice and ceremony to a marked extent, but have had much less to do with the growth of dogma than the intricate details of the history of the gods, to which the numerous phenomena of nature gave rise. Over religious belief the sun has exercised a dominant influence, and still faintly yet distinguishably shines through the most opaquely obscure of modern theological dogmas."

In a paper on *Teaching School Children to Think* (D. Appleton & Co.), Prof. *George B. Newcomb* discusses first the question, "What is the capacity and exercise of the mind which is indicated by the terms 'thought' and 'thinking'?" He shows that in the reaction from the old mechanical drill we should avoid going to the opposite extreme of taxing the child's mind beyond its powers. The faculty of thinking is a growth, and needs to be dealt with according to the stage of development it has reached. Capacity to form abstract ideas and reason consecutively does not come at once; "yet long before reasoning, strictly so called, is developed, there is rationality, the exercise of intelligence in unifying the scattered particulars of sense; in correlating facts and lighting up one fact by another"; and it is all alive in the child's mind, in the curiosity that asks the reason why. While children dislike remote abstractions, they are capable of general thought and rational connecting, and make crude attempts at rational synthesis. The manifestations of these faculties may be watched for and taken advantage of and directed as they appear, and the child thus be led gradually up to the habit of rational thought on every subject. This precept partly furnishes the answer to the author's second question, "In what sense or within what limits, if any, should the development of thought be a prominent aim in the training of school children?" A third question, involving the consideration of ways and means for developing rational intelligence in the pupil, is too large for treatment in a single paper; and upon it the author aims only to enunciate broad principles or make helpful suggestions without going into details.

In *A Rambler's Lease*, Mr. *Bradford Torrey*, one of the most pleasant of our rural essayists, assumes the position of a leasehold tenant of other people's fields and woods to the extent of the æsthetic enjoyment and opportunities for the study of life and nature that they afford. He therefore makes himself at home in them, and keeps company with the trees and flowers and insects and birds; with some of which he has enjoyed privileges of rarely close association. The present volume contains some of the fruits which he has gathered in these possessions; seemly and agreeable fruits in every way, and flavored with occasional choice grains of wit. In it he introduces us to the wild birds which he has become so intimate with as to feed them by hand; reports his observations on climatology and seasonal phenomena; draws the lessons to be learned from a ramble in "an old road"; exalts the man "behind the eye" rather than the eye as the important factor in observation, and the mental attitude in "taking a walk"; and presents studies of mountain scenes, "butterfly psychology," and the means by which the partridge executes his "drumming." (Houghton, Mifflin & Co., $1.25.)

The Anatomy of Astrangia Danæ, published in quarto form by the Smithsonian Institution, comprises six lithographs from drawings made by *A. Sonrel*, under the direction of Prof. Agassiz in 1849, illustrating the structure of that madrepore, the only representative of the family in shallow New England waters, with text explaining the plates by *J. Walter Fewkes*. Although there has been a great advance in histological methods since the figures were drawn, it has hardly extended to the minute anatomy of these creatures; so that the representations are nearly as fresh as if they had been drawn to-day. Whatever may be lacking to bring them up to the present state of knowledge is supplied in Mr. Fewkes's descriptions, which are based on studies of living specimens.

Studies of the Macrochires, Morphological and otherwise, with the View of indicating their Relationships and defining their Several Positions in the System, by *R. W. Shufeldt, M. D.*, bear upon the comparative anatomy and place of the swifts, whip-poor-wills, and humming-birds. The author had already proposed a separate order for the *Trochili*, or humming-birds, and is more than ever convinced of the correctness of his scheme. In the present essay he proposes a new group or order—that of *Cypseli*—for the swifts. This order, were it represented by a circle, would be found just outside the passerine circle, "but tangent to a point in its periphery opposite the swallows.

In a monograph on *The World's Supply of Fuel*, Prof. *W J McGee* describes rock gas and its occurrence; accounts for its formation by the decomposition of the organic matter contained in sediments; answers in the affirmative the question whether it is still forming, and adds that it will probably continue to form indefinitely, though at a decreasing rate; and predicts that it is destined to be, after the coal has been exhausted, the world's unfailing supply of fuel and light.

The address of Prof. *Charles A. White*, as Vice-President of the Geological Section of the American Association, is devoted to the survey and definition of *The North American Mesozoic*, particularly of the formation called Triassic. There are doubts about the correspondence of this with European formations; and this and certain other facts give occasion for the expression, with some fullness, of the opinion that we must not expect to discover a precise correspondence, either in time or character, in the geological history of our own and other continents, or an exact identity of formations in them. Hence, with all respect to European classification and names, which may still be used tentatively in each of the great divisions of the earth, and with reference to the ultimate establishment of a universal system, it is for North American geologists to elaborate a scheme for the formations of our own continent.

In a pair of papers on *Meteorites and what they teach us*, Dr. *H. Hensoldt* summarizes what has been learned about meteorites, and declares his own theory as to their origin. This theory is based on the presence of liquid carbonic acid in the cavities of these bodies. The fluid is ascertained to be carbonic acid by the instantaneous change of form which it undergoes between 30° and 31° C., which is characteristic of that substance. Now, carbonic acid can not be liquefied except under a pressure which exists in nature only deep in the earth. Hence the meteorites must have been at some time subjected to such a pressure. It is therefore concluded that they have come from the interior of some planetary body which has been rent by an explosion.

Proceedings of the Boston Society of Natural History, Vol. XXIV, contains the reports of the society and its proceedings, with the papers read, from May, 1888, to May, 1889. Prof. Hyatt's report as curator of the museum shows that that institution is growing at a healthy rate, and the arrangement of its collections is going forward. The papers relate to various topics of biology, geology, and archæology. Among them are those of Prof. Hyatt on the "Evolution of the Fauna of the Lower Lias"; of Mr. S. H. Scudder on a Palæozoic "Cockroach Fauna" at Richmond, Ohio; of Prof. Marcou on "Canadian Geological Classification for the Province of Quebec"; of Mr. Alfred C. Lane on the "Geology of Nahant"; of Mr. Warren Upham on "Marine Shells and Fragments of Shells in the Till near Boston"; of Mr. Samuel Garman on the "Evolution of the Rattlesnake"; and of Prof. Goodall on the "Life and Work of Dr. Asa Gray."

Several archæological papers, which appear in this volume of the "Proceedings," are also published separately by the Peabody Museum of American Archæology and Ethnology, under the title of *Palæolithic Man in Eastern and Central America.* They are "Early Man in the Delaware Valley," including an account of the lately discovered "Rock Shelter" at Naaman's Creek, and descriptions of Palæolithic implements; and an account of an implement from the Indiana gravel, by Hilborne T. Cresson; Prof. G. F. Wright's paper on the "Age of the Philadelphia Red Gravel"; "Water-worn Implements from the Delaware River," by Dr. C. C. Abbott; and remarks on the whole subject by President F. W. Putnam. Prof. Wright's paper bears upon the age of the rock shelter and of the implements in the Delaware Valley described by Mr. Cresson, which the author decides are older (perhaps by a thousand years) than the deposits at Trenton, N. J., Loveland and Madisonville, Ohio, Little Falls, Minn., and Medora, Ind. (Cresson).

An Obsidian Implement from Pleistocene Deposits in Nevada, by *W J McGee*, discusses the age of a handsome neolithic work found on Walker River, to which the author has already made reference in the "Monthly" (November, 1888, p. 25). The solution of the question is partly dependent upon the character of the occurrence of the implement—whether it be adventitious or normally *in situ*. The deposit being unconsolidated, this can not be determined certainly without the help of other human relics found in the same place to keep it company; and such have not been found. But, since the implement was observed, the discovery of other extremely ancient relics in various parts of the country has given color to the hypothesis that this was an original deposit; and the author now inclines to that view.

The Aborigines of the District of Columbia and the Lower Potomac—a symposium in the Anthropological Society of Washington—besides an address by Otis T. Mason, introducing the subject, contains papers on "The Geological Antecedents of Man in the Potomac Valley," by W J McGee; "The Palæolithic Period in the District of Columbia," by Thomas Wilson; "Ancient Village Sites and Aboriginal Workshops," by S. V. Proudfit; "The Pottery and Textiles of the Tide-Water Region," by W. H. Holmes; "The Shell Mounds of the Potomac and Micomico," by Elmer R. Reynolds; "Indian Tribes of the District," by James Mooney; and a discussion by Prof. F. W. Putnam.

Of six additional "Bulletins" of the United States Geological Survey, No. 48 is *On the Form and Position of the Sea-Level*, with special reference to its dependence on superficial masses symmetrically disposed about a normal to the earth's surface, by *Robert Simpson Woodward*. The treatise is mathematical, and relates to a problem of peculiar difficulty, the solution of which has been as yet only approached. The same author's *Latitudes and Longitudes of Certain Points in Missouri, Kansas, and New Mexico*, constituting "Bulletin No. 49," relates to the processes of determination at Oswego, Elk Falls, and Fort Scott, Kan.; Springfield and Bolivar, Mo.; and Albuquerque, N. M. The author has endeavored to collect, arrange, and discuss the observations in such a manner as to render their results most useful for the purposes of geography and geodesy. Bulletin No. 50, also by Mr. Woodward, consists of *Formulas and Tables to facilitate the Construction of Maps*. The tables were prepared for the Division of Geography in 1885-'86. Constant use since then has demonstrated their utility. They have been revised and extended, and are accompanied by an explanatory text. Dr. *Charles A. White* gives, in Bulletin No. 51, descriptions of some *Invertebrate Fossils from the Pacific Coast*. They fall under five headings: "New Mollusca from the Chico-Tejon Series of California," representing nineteen new species and one new genus; "The Occurrence of Equivalents of the Chico-Tejon Series in Oregon and Washington Territory"; "Cretaceous Fossils from Vancouver Island Region," in which an intimate relation is shown with the fauna of the Chico group; "The Molluscan Fauna of the Puget Group," unique and indicating deposition in a large estuary; and "Mesozoic Mollusca from the Southern Coast of the Alaskan Peninsula," which are regarded as new. No. 52, *Subaërial Decay of Rocks and Origin of the Red Color of Certain Formations*, relates studies of the subject by *Israel Clark Russell*, chiefly among the Appalachian Mountains in Virginia and North Carolina. The author believes that changes by decay have a wider geological bearing than has generally been assigned to them; and that the red color of certain sandstones is due to a coating of their particles with ferric oxide received during the process of subaërial decay of the rocks of the *débris* of which they are composed. The last of the present series of Bulletins—No. 53—is a study of *The Geology of Nantucket*, by Prof. *N. S. Shaler*. The island is regarded, together with the accompanying southern Massachusetts coast, Martha's Vineyard, Long Island, etc., as "the dissevered remains of a great shelf formed of the *débris* brought to its present position by the glacial ice and by the streams of water which flowed beneath it."

The United States Department of Agriculture, Division of Entomology, publishes an investigation of *The Root-knot Disease of the Peach, Orange, and other Plants in Florida, due to the Work of Anguillula*, made under its direction, in 1888, by Dr. *J. C. Neal*. A large number of species of plants are attacked by the worms, whose depredations are marked by the appearance of swellings or "knots" on the roots, and threaten to be damaging. The author has made studies of the nature of the insect and its ravages, and has experimented with reference to the remedies. His report is illustrated with plates representing attacked roots and the life-history of the enemy.

The June number of the *Journal of Morphology*, Vol. III, No. 1 (Prof. *C. O. Whitman* and *Edward Phelps Allis, Jr.*, editors; Ginn & Co.), contains articles on "The Actiniaria of the Bahama Islands," by Dr. J. Playfair McMurrich; "Contributions to the Comparative Osteology of the Families of North American Passeres," and "Notes on the Anatomy of *Speotyto cunicularia hypogea*," by Dr. R. W. Shufeldt; and "Variation of the Spinal Nerves in the Caudal Region of the Domestic Pigeon," by James I. Peck. The September number, Vol. III, No. 2, has "The Mechanical Causes of the Development of the Hard Parts of the Mammalia," by E. D. Cope; and "The Embryology of *Blatta germanica* and *Doryphora decemlineata*"—the cockroach and the Colorado potato beetle—by William M. Wheeler.

A Bibliography of Geodesy was compiled by Prof. *J. Howard Gore* to supply a need which he felt while preparing a work on the "History of Geodesy." Before proceeding far in that work he found it very difficult at any time to make sure that the literature regarding the operations of a given period had been exhausted, and he sought to collect titles as well as the works themselves. His purpose extended to making the enterprise useful to others. He went abroad and searched through European libraries, examined minor libraries by proxy, and corresponded with authors to find if they had any other works than those of which he had the titles. The outcome of this persevering labor is a list filling four hundred columns of references, with short remarks where the title alone is not explanatory enough. Several institutions, among them the International Geodetic Congress of Berlin, offered to publish the book; but the author thought our Coast and Geodetic Survey was entitled to the preference, and the work is therefore issued under its auspices.

Part I of the nineteenth volume of the "Annals of the Observatory of Harvard College" contains *Meteorological Observations made during the Years 1840 to 1888 inclusive*, under the direction of the several directors of the observatory, Profs. *W. C.* and *G. P. Bond*, *Joseph Winlock*, and *E. C. Pickering*. Partial publications of these observations could already be found in the "Memoirs" of the American Academy of Arts and Sciences, the "American Almanac," and the Patent-Office Reports, but it has seemed desirable to make a collection of the monthly means. The volume begins with a history of the meteorological work of the observatory; the "monthly and annual results" come next; after which follow "Observations of Aurora Borealis," "Thunder and Lightning," and "Miscellaneous Phenomena," embracing "temperatures of wells," of "river, rain, and cellar," "Extremes of Atmospheric Pressure or Temperature," "Solar Halos and Parhelia," lunar halos, and "General Remarks."—Vol. XX, Part II, of the same series records the *Observations made at the Blue Hill Meteorological Observatory*, Massachusetts, in 1888, with a statement of the local weather predictions, under the direction of *A. Lawrence Rotch*.

A paper on *Domestic Economy in Public Education*, by Mrs. *Ellen H. Richards*, of the Massachusetts Institute of Technology, is published in the series of "Educational Monographs" of the New York College for the Training of Teachers. The success of the manual training system that has been developed out of the carpentry classes for boys has prompted the author to look for a kindred course adapted to the life of girls. She finds it in domestic economy, in which the purposes of sanitary science and hygiene should play an important part. A schedule for a four years' course is introduced. In it cooking—"kitchen science"—is prominent, and this, the author insists, can be placed on a level with the use of workshop tools as a means of mental and physical training. Having mentioned the scientific principles involved in the processes of preparing a meal, the author maintains that "the school-girl who has had the elements of chemistry and physics, which are often taught as abstract sciences, summed up and applied to the making of a simple dish, has had her mind awakened to the relations and interdependence of things as no other training now given can awaken it." In an appendix are given summaries of the provisions made for teaching domestic economy in several public schools and colleges in the United States and in the girls' schools of the city of Paris.—Another number of the same series is an essay on *Graphic Methods in Teaching*, by *Charles Barnard*, with an introduction by Prof. *John F. Woodhull*, setting forth "Training in Natural Science as an Essential Factor in the Education of the Citizen." Mr. Barnard's essay embodies the relation of experiences in training children to the observation of natural facts and phenomena, and to keeping regular records of them by means of the graphic system, with specimens of the actual work of certain children in that line. Of the value to the child of thus recording weather observations the author says: "The making of the diagram (printed forms should never be used) is something in the way of mechanical drawing that is a good training for the hand and eye. Secondly, the diagram, being fastened upon the wall in some convenient place, becomes a reminder of stated work to be done at a fixed hour—a capital training in punctuality, promptness, and precision." Then the thermometer is a tool which the child learns to use. He is induced to go out of doors. Pride is taken in the work as it goes on, developing a regular course. It is instructive and a useful exercise in neatness and accuracy, and when it is done "the child has two graphic statements of real phenomena in nature observed by himself and so recorded that at the end the entire work of the month is plainly seen."

The Globe, a New Quarterly Review of World-Literature, Society, Religion, Art, and Politics, of which we have the first number, October to December, 1889, is projected by *William Henry Thorne*, in Chicago, to be a "first-class literary review," which he believes we have not; and he aspires "to edit and publish something better, broader, stronger, and more cosmopolitan" than any existing American periodical. After a careful inspection of his work we are forced to say with regret that he has not reached the object of his aspiration, and that the want he describes, if it existed before, is still unsupplied. The initial number of *The Globe* contains articles on "The Fuss about Bruno," "The English, French, and American Stage," "The Heroic and Commonplace in Art," "Emerson and his Biographers," "Socialism and Poetic Retribution," "Dr. McCosh and Modern Philosophy," etc.

Edenic Diet, the Philosophy of Eating for the Physical and Mental Man (Isaac B. Rumford, Santa Cruz, Cal., 25 cents), is intended primarily to exalt an exclusive vegetable diet and furnish recipes involving its principles. To this are added a mass of rhapsodical matter and a scheme for "an Edenic home" which those may enjoy to whose mode of thought they are adapted.

Mr. J. Madison Cutts, of Washington,

has published, as especially pertinent to the times, an address by the late *Stephen A. Douglas* on *An American Continental Commercial Union or Alliance*. It is, he says, the last paper written by the distinguished statesman, and has not been published before. It was prepared after seven of the Southern States had gone through the form of seceding, and was intended to serve as one of Mr. Douglas's immediate plans to promote the future welfare of the country in case a reconciliation and restoration were effected. Besides its interest as the last thought of one of the most distinguished statesmen of the period before the war, the address is pertinent on account of its direct bearing on a scheme of national policy which is now under discussion.

In an essay on *God and the Universe*, Mr. *James W. Stillman* proposes to consider "the alleged existence of a Supreme Being and the theistic hypothesis of creation." He is brought to the conclusion that "the whole problem of the existence of God and the origin of the universe is entirely beyond and above the scope of the human intellect"; and there he is content to leave the matter.

In a pamphlet on *The Disposal of the Dead*, Dr. *John M. Peacocke*, of Brooklyn, after considering other methods, suggests desiccation, which was practiced by the ancient Peruvians, as in many respects the preferable one.

Questions for Debate in politics and economics is the latest publication (No. XXVIII) of the Society for Political Education, 330 Pearl Street, New York. A perusal of its pages shows its compilers to have seized upon every living issue affecting American citizenship. In addition to the questions, subjects for essays are given, as well as terms for definition. Brief and pithy hints to debaters and essay-writers are included, as also a form of constitution and by-laws for debating-clubs. Pages 40. Price, 25 cents.

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POPULAR MISCELLANY.

Flour-making in the Northwest.—Mr. Charles A. Pillsbury, of Minneapolis, states that the manufacture of flour is to-day probably the largest industry in the United States, not excepting that of iron. About 85,000,000 barrels of flour, of an average value of about $400,000,000, are made in this country yearly. About ten per cent of this product is manufactured in Minneapolis. As much as 1,000 car-loads of wheat are often received at Minneapolis in a single day, or enough to load a train six miles long. To say that flour made from Minnesota and Dakota wheat is the best in the world is only saying what is recognized by the trade the world over, in the prices which it brings as compared with other flours. Wheat grown in this latitude has so large a proportion of gluten and phosphates that it is gradually but surely crowding more starchy flours to the wall. When Mr. Pillsbury began milling twenty years ago, he secretly brought flour from St. Louis to use in his own family. Minneapolis flour sold very much below that made in other sections of this country, and stood at the foot of the list in market quotations. Now it stands at the top of the list. A Board of Trade report, of the city of Minneapolis, for 1866, stated that the production of flour in the city during that year was 172,000 barrels; now it is forty times as much. Only eleven years ago the amount of flour made in Minneapolis and exported from this country was 109,183 barrels; now it is over 3,000,000, or thirty times as much. It is the improvement which has been made in milling in this section which has accomplished these results. It has also made the rapid settlement of the Northwest possible, as wheat is by all odds the chief crop of that region. On the other hand, the rapid increase of the farming population in the tributary country has made possible the rapid increase of mills in Minneapolis. Another thing that has contributed largely to this result is cheap transportation to the East. A few years ago the millers were paying one dollar and a half a barrel to get their flour carried to the seaboard; now the rate is only fifty-five cents. Mr. Pillsbury deems it quite possible that the flour industry of the Northwest is even yet in its infancy, as probably not more than ten per cent of the available land tributary to Minneapolis has been placed under cultivation.

Aboriginal Mounds in Manitoba.—The Winnipeg mound region, as described in the American Association, by Prof. George Byles, of Manitoba College, includes a district some four hundred miles long from east to west, and running from the international boundary north to at least latitude 50°. The author had seen some sixty mounds and had opened ten, working usually in connection with the Manitoba Historical Society. Numerous skeletons have been exhumed. Unmanufactured articles found included large quantities of charcoal—red and yellow ochre and birch bark charred. Manufactured articles: Stone implements, scrapers, gouges, chisels, axes, malls, conjurers' tubes, and a set of gaming stones. Bones: Breast ornaments of various kinds, whistles, beads, etc. Shells: Columella of conch from trophies, tropical natica and marginetta shells made into beads, wampum, and breast ornaments. Horn: Fish-spear, pottery, numerous marked fragments, various copper implements, and near one skeleton two lumps of arsenical pyrites, no doubt used as sacred objects. All mounds were circular, and all on prominent headlands. The majority contained skeletons, probably of Mandans of the Missouri, who fifty years ago were almost exterminated by small-pox. Certain mounds, from the state of the bones and certain topographical and geological considerations, are likely to date from the beginning of their central parts four hundred years back.

Tapestries.—The word tapestry has primary reference to carpets. As now used, we learn from a lecture by Mr. Alan S. Cole upon the subject, it may be read in two senses: one in which it refers to hangings generally; and the other in which it implies a special method of producing a textile fabric. In making carpet by hand, as in ordinary weaving, a stretched warp is necessary; but the warp-threads play no visible part in the face of the carpet. They are covered with weft-threads. Instead of a shuttle with a weft, as in weaving, various sets of thread are used, which are looped, knotted, and intertwined upon the warp-threads. In making carpets with a pile, the ends of the threads which have been knotted upon the warp are cut. From above these knotted threads, and across and in between the warp-threads, a stout thread is thrown. This is pressed down with a comb, so as to compact the whole fabric. A fresh series of knottings is then made, and the previous operations are repeated. In another closely allied process for making carpets and hangings, a stout cord is thrown across and in between the warp-threads; no scissors are used to cut the ends of knotted warp-threads, and no pile is produced. This process requires the variously colored wefts to be intertwisted between groups of the warp-threads; and in this respect it is almost identical with that particular process which is known as tapestry-making; but tapestries are finished for display on one side only. They are made upon vertical threads, when they are high-warp or *haute lisse*, or upon horizontal threads, when they are low-warp or *basse lisse*, tapestries. But the results of both methods are virtually identical, so that it is almost impossible to detect any peculiarity which shall distinguish one from the other. The earlier hangings appear to have been of lighter material than that of the special fabric; and they were ornamented by weaving, embroidery, or painting. The special process was applied in early times to making small ornamental trimmings for costume. Its application to works on a much larger scale appears to date from the twelfth and thirteenth centuries, although it had probably been already employed in old Asiatic civilizations for carpets. The number of colors of the earlier tapestries was restricted, but, after the tapestry-making craft was established, a more generous scheme of colors was employed. This has developed in such a way that it is a boast now at the Gobelins factory that they have upward of fourteen thousand four hundred tons of colors in dyes for threads.

Our Arid Regions and the Rainfall.—The soils of the arid regions of the United States, according to the paper read by Prof. J. R. Dodge at the meeting of the American Association, are generally fertile to excess. The only amelioration they require is that which is secured by the application of water. That may be obtained from natural precipitation; by irrigation from supplies at present available or from storage reservoirs and catch-basins to be erected to hold the surplus of rains; by pumping from the underground channels of streams; or by means of artesian wells. After all available water has been obtained by these means and expedients, there is still a large part of the superficial area that must remain unirrigated. Some say that this part constitutes four fifths or five sixths of the whole, but those who have an intimate knowledge of the practical work of irrigation insist that it is not more than one tenth or one eighth of the area. *Still*, the remainder is not quite a desert. There are what are called agricultural rain-belts which, with from fifteen to eighteen inches of water, sometimes twenty inches per annum, are found to produce good crops of corn up to an elevation of three thousand or four thousand feet, and wheat, oats, potatoes, alfalfa, and many grasses up to six thousand or seven thousand feet, by adaptation of methods of cultivation to suit the best utilization of available moisture. The question of increasing rainfall gains an affirmative answer from practical cultivators, while the records of the rain-gauge fail to make such a response. There is an increase, if not in actual rain, certainly in available moisture; for the water which formerly flowed away with as much facility as from the back of a duck, is nearly all retained by cultivated lands. If the irrigation is general and continued for years, there is a change of climate, with more moisture in the atmosphere, dews at night frequent where they were formerly unknown, and general enhancement of the agricultural value of the air.

The Beauty of Childhood.—A recent discovery of classical sculptures has recalled attention to the fact that the ancients had, so far as appears from their works, no appreciation of the beauty of childhood. In the present instance, in which the figures relate to death scenes and include family pictures, while the mature characters are represented with the best skill which the artist could command, the children—at the age fullest of beauty for a modern eye—are executed with archaic clumsiness. Miss Harrison has pointed out, in her lectures on Greek sculpture, that representations of infancy are characteristic of the decaying art of Alexandria; the best period of art affords no specimen of such a choice of subject. "The artists whose work has afforded models for all time have not left a single specimen of that beauty which modern eyes most admire, the beauty of childhood." And in Grecian and Roman literature there is none of that happy picturing, that dwelling with delight upon the beauties of childhood that seem to have entered into the very essence of modern natures. To the Romans, "infancy was only a journey toward manhood; the sooner it was over the better." In the reference to childhood which is most truly affecting of all in ancient literature, the fright of the child in Homer's "Parting of Hector and Andromache," the interest, "if we analyze it, belongs rather to an impartial delineation of human life as it is, than to any sympathy with the helplessness and dependence of its earliest stage." While modern art does not show an equal lack of the taste for childhood, it "is comparatively feeble at all times in comparison with the feeling of our own day." This feeling is reflected in its intensity first in the poems of Wordsworth and the pictures of Sir Joshua Reynolds. "This sympathy with childhood," says the writer in the "Spectator" whose essay we have summarized, "which gives its coloring to modern literature and art, is to be traced back to utterances which have influenced more than the literature and art of modern Europe. 'Except ye become as little children, ye can not enter into the kingdom of heaven,' was a saying new to the world. The fresh aspect under which all weakness, all dependence, appeared in the light of that teaching, was evidently bewildering to its hearers." It took centuries for the Christian world to take in the full meaning of that utterance, which has not been realized as a fact of ordinary life till nearly our own time. But now, "for a year or two in this pilgrimage of ours, the most commonplace, the most tiresome of us is invested with this wonderful capacity [of persuasion and conciliation]; every human being has once upon a time hushed enmities and bridged estrangement."

Iron as a Purifier of Water.—The power of iron to remove coloring matter and organic contamination from impure waters has been made capable, by recent improvements in processes, of receiving a greatly extended application. In Prof. Bischof's system, a sand filter which separates the mechanical impurities is underlaid by a mixture of gravel and iron in the proportion of three parts to one. When the water is drawn off from this filter after using, no discoloration is visible in the upper sand, nor till near the iron mixture. In this the particles of gravel and iron become thickly coated and mixed with the reddish, slimy product of the chemical action of the iron; and, still lower down, the mixture is black, and not subject to change. The slimy-coated mixture has to be removed and washed every six months. By another improvement the iron is presented in a state of constant agitation, and the slimy coating being washed away as fast as it is formed, an always clean surface is offered to the water. The working of the method is satisfactory, and may, by adding fresh iron from time to time, be made nearly continuous. The purification depends upon the chemical action of iron on organic matter in solution, and its property of coagulating very finely divided particles of matter so that they can be removed by filtration. The iron, in this process, changes the chemical nature of the organic matter and greatly reduces the albuminoid ammonia; softens the hard scales that form in boilers, and destroys or removes much of the infusorial life in the water.

A Bit of Triassic History.—Mr. W. M. Davis's study of the "Topographic Development of the Triassic Formation of the Connecticut Valley" shows that the country from northwest to southeast suffered from repeated faultings after the trap sheets had taken their places, as extensive surface-flows, in the stratified series, the trend of the faults being to the southwest. The initial constructional regions are represented by the faulted blocks of southern Idaho. A mountainous variety of form prevailed—which may provisionally be called the Jurassic stage of the evolution of the district; but in time—during the Cretaceous—the faulted ridges were reduced to a low, base-leveled plain, in which the present valleys were worn after its elevation. The Connecticut River was originally consequent on the monoclinal faulting; and, while it has entered on a second cycle of life as a result of the elevation of the lowland that was produced in its first cycle, it still persists in the course it first took.

Uranium.—It is now a hundred years since Klaproth (in 1789) discovered the metal which he named after the planet Uranus, then recently discovered by Herschel. Uranic oxide, which is yellow, is used to produce a beautiful golden color, and, with other minerals, opalescent tints in glass and porcelain. The pentoxide is black, and is used in the production of costly black porcelain and the dark tints in majolica-ware. The chloride of uranium is coming into use as a substitute for the chloride of gold in photography. It is anticipated that two extensive fields for the employment of the metal will soon be opened. One is as a substitute for gold in electroplated ware, for with platinum and copper it forms two beautiful yellow alloys. Its platinum alloy has a special value from its power of resistance to the action of acids. The other use will be found in electric installations, and depends on its high electrical resistance. Uranium has hitherto been found only in pockets or patches in Bohemia, Saxony, and Cornwall, but in the centennial year of its discovery a lode of the metal which promises a large supply was found in the latter region.

A Chemist's Services to Mankind.—In a recent address on the life-work of Pasteur, Sir Henry E. Roscoe emphasized the benefits to humanity which have resulted from the researches of the great French chemist. "The first and obvious endeavor of every cultivator of science," he said, "ought to be to render service of this kind. For, although it is foolish and short-sighted to decry the pursuit of any form of scientific study because it may be as yet far removed from practical application to the wants of man, and although such studies may be of great value as an incentive to intellectual activity, yet the statement is so evident as to almost amount to a truism, that discoveries which give us the power of rescuing a population from starvation, or which tend to diminish the ills that flesh, whether of man or beast, is heir to, must deservedly attract more attention and create a more general interest than others having so far no direct bearing on the welfare of the race." Pasteur's series of valuable labors, including the discovery of the causes and remedies for the sicknesses which wine and beer undergo, the cure of the silk-worm disease, the existence of which in one year cost France more than one hundred millions of francs, the extermination of fowl-cholera, and of the fatal disease known as anthrax in cattle and wool-sorters' disease in man, culminates in his discovery of a successful treatment for rabies. Prof. Roscoe gives an idea of the wide demand for the treatment of Pasteur's laboratory in these words: "There I saw the French peasant and the Russian *moujik* (suffering from the terrible bites of rabid wolves), the swarthy Arab, the English policeman, with women too and children of every age, in all perhaps a hundred patients. All were there undergoing the careful and kindly treatment which was to insure them against a horrible death. Such a sight will not be easily forgotten. By degrees this wonderful cure for so deadly a disease attracted the attention of men of science throughout the civilized world. The French nation raised a monument to the discoverer better than any statue, in the shape of the 'Pasteur Institute'—an institution devoted to carrying out in practice this anti-rabic treatment, with laboratories and every other convenience for extending by research our knowledge of the preventive treatment of infectious disease." The contrast between the spirit of science and the spirit of war is well expressed in Pasteur's own words at the opening of this institute: "Two adverse laws seem to me now in contest. One law of blood and death, opening out each day new modes of destruction, forces nations to be always ready for the battle-field. The other, a law of peace, of work, of safety, whose only study is to deliver man from the calamities which beset him."

The Cotton Fiber.—Mr. Thomas Pray, Jr., in a lecture before the Franklin Institute, said that the ordinary way of judging raw cotton by feeling with the fingers was exceedingly crude, seeing that the fibers vary all the way from $\frac{1}{500}$ of an inch in thickness for the coarsest "upland," to $\frac{1}{2000}$ for the best Sea Island cotton. Some few cotton-spinners have now been induced by Mr. Pray to adopt the microscope in examining cotton. The finest cotton raised in any of the fields of the world comes from the Mississippi delta. Under the microscope it is seen to be beautiful in structure, of perfect development, full of oil deposits, and having nearly four hundred spirals per inch. It makes very strong yarn, capable of coloring all the delicate shades, like pink, and bleaches in the most perfect manner. Dyers frequently find spots in cotton goods that will not take color at all, or only unevenly. Certain pieces can not be printed or colored anything but black. If fibers of such cotton are looked at under the microscope after being mordanted, some parts will be seen prepared for coloring, and others where the mordant has not taken hold. Cotton is often badly damaged by poor ginning; the fibers are torn, and millions of short pieces to every bale are broken off, which in spinning fly all over the mill and machinery, and go into the waste instead of being made into yarn. Much has been said about "parallelism" of cotton fibers in the manufactured goods, but, if a bit of one of the best grades of cotton cloth made is examined under the microscope, there is seen to be no such thing as parallelism among the fibers.

Snow-Blindness.—Snow-blindness, according to Dr. Berlin, of Nordenskiöld's Expedition to Greenland of 1883, is met with as far north as any arctic expedition has penetrated, but is unknown, except sporadically in high mountains, south of certain degrees of latitude. It follows the sinuosities of the isothermal lines. In the arctic regions it breaks out usually in the spring-time, but also occurs in summer wherever snow remains. It appears during snowstorms and fogs, as well as when the sun is shining. The prominent symptom is an intense burning pain in the eyes, beginning with a prickling sensation as if produced by a foreign body, with increased secretion of tears, photophobia, and blepharospasm. The visual power is not diminished, but the field is narrowed. Most cases will get well at the end of two or three days, if the patient guards himself against the exciting causes; or the disease may, exceptionally, become a serious matter. It is not a dazzling caused by the snow, for dazzling does not produce its effects, and it does not prevail everywhere that there are snow and sunlight; nor can it be explained by the fact of the rarefaction of the air. It is probably a result of the low temperature and the want of humidity in the air which characterize the places where it prevails. As it is the humidity of the air which principally absorbs the radiant heat, the caloric rays of the sun must, in those localities, manifest an intensity of action far above the common. Observation has shown that this is the case, for on high mountains and in the arctic regions exposure to the sun's rays produces on the bare skin an excessively painful dermatitis, which the radiant heat reflected by the snow very much aggravates. The effects of exposure to the sun appear to be most severe in spring-time. The eyes are affected simultaneously with the skin or somewhat previously. The ordinary treatment of snow-blindness consists in the use of spectacles of dark-colored glass, with opiates to relieve the pain. Blackening of the nose has been found by several travelers to be an effective remedy.

The Great Hall of the Mammoth Cave.—Some important new discoveries in the Mammoth Cave were described by the Rev. Dr. H. C. Hovey at the meeting of the American Association. They are connected with the arrangement of the cave passages in tiers and the great pits or domes. Following the guide across a treacherous chasm known as the covered pit, the author found a series of these chasms exceeding in size any that had ever been discovered before. He afterward visited the pits with a photographer, Mr. Ben Hains, and means for taking photographs. As measured from above, they varied from forty-seven to one hundred and thirty-five feet in depth. With much difficulty and risk he succeeded in reaching the bottom of Charybdis, the deepest of the pits, and there discovered, by the aid of chemical fires, that the whole series of pits, eight in all, were joined at the bottom into one magnificent hall several hundred feet long. This hall was traversed from end to end. Dr. Hovey proposes to name it Harrison's Hall, after the President of the United States.

NOTES.

A BACTERIAL disease of carnations was described by Prof. J. C. Arthur at the meeting of the American Association. It is revealed by the presence in the leaves of transparent dots that can be seen only by transmitted light. These spots increase and coalesce, and finally kill the tissues, when the leaves dry up and the plant gradually dies. The transparent spots are found, under the microscope, to be due to the enlargement of the cells with bacteria.

WHEN the governor of a province in Madagascar wishes to issue a proclamation, he sends out, according to Mr. L. H. Ransome, messengers to all the villages under his control, bidding the principal men from each to assemble at an appointed time; this gathering is called a *kabary*. When all those summoned are present, the governor or his deputy reads aloud the proclamation, which then becomes law, the representatives of each village being responsible for its publicity. Sometimes justice is administered at a *kabary* of this kind, when the governor pronounces sentence, after hearing the evidence on both sides.

A method of sewage purification called the "Amines" process is being tried at Wimbledon (England) Sewage Farm. It is so named because it employs certain basic carbon compounds called *amines*, together with milk of lime. At present herring-brine is the cheapest substance which contains the amines. When the brine is introduced into freshly made milk of lime it is decomposed and a very soluble reagent is evolved, to which the inventor has given the name "aminol." This substance has a peculiar briny odor, and when introduced into sewage is said to extirpate all micro-organisms capable of causing putrefaction and disease.

A committee of the Royal Society has been appointed on the erection of a national memorial to Dr. Joule.

A specimen of the crested starling (*Fregilupus varius*), of Réunion Island, has recently been obtained for the British Museum. This bird, which has been probably exterminated, is rarer in collections than the great auk. Its coloring consists simply of black, white, and gray, but when alive it must have been a graceful bird. Some creoles on the islands, who remembered the bird in their younger days, told the late Mr. Pollen that it was so tame and stupid that it could be knocked over with a stick. Only sixteen specimens are known to exist, and there is none in any American museum.

Concerning "the grass problem in Nebraska," Prof. Bessey, at the agricultural meeting of the American Association, mentioned places where buffalo grass is plentiful, and others where the soil is a moving sand, that gradually becomes covered with native American grasses. In older tracts, timothy has been introduced, Kentucky blue grass is grown successfully, and clovers are doing well. Prof. Beal, in a paper on "Wild Grasses under Cultivation," said that he had found in his researches many wild grasses that were valuable, and advised selections for experiment.

Prof. Fernow is quoted in the "Toronto Globe" as advancing, in an interview, the opinion, respecting the influence of forests on climate, that the lack of moisture on the plains of a large portion of the West was due not so much to deficient rainfall as to excessive evaporation, which in turn was due to the unchecked action of the wind. Were there wind-breaks in the form of patches of trees in that country, part of the land would be thereby reclaimed, and the reclamation of the rest would be rendered far more easy. The proposition of Major Powell, to remove the forests from the crown of the Rocky Mountains, as a means of improving the water conditions of the desert, he regarded as preposterous, and opposed to all our knowledge regarding the natural conditions of mountainous districts.

Dr. von Reuben Paschnitz having concluded that when earthquake-shocks occur simultaneously at different places, as recently happened in Japan and Germany, a connection may be presumed between them, Mr. William White has presented some very forcible arguments in "Nature" in support of an opposite view.

A statue of the French chemist, Nicolas Leblanc, has been erected at Saint-Denis, where he had a manufactory.

While the enormous output of coal during the last few years has not actually crippled British fuel resources, Prof. Hull anticipates a general rise in the value of coal in the near future, on account of the great depth at which the mines will have to be worked, and the increased cost of coal-mining.

Both the Russian and English engineers are planting trees extensively as an aid to their operations in Central Asia. The Russians, under the direction of General Annenkoff, are especially active in this work. Orders have been given that no bushes are to be cut down within ten miles of the Transcaspian Railway, and that the existing forests of saxaul are to be preserved. Plantations of this, which is a kind of brier-wood, are to be made along the line, with camel-thorn and other native bushes that thrive well. It is expected that these will protect the line and provide shelter for weaker trees and bushes of foreign origin. The tree-planting of the last three years has not been a complete success, but experience has shown what varieties will and what will not thrive.

The London "Spectator" publishes letters showing that the idea that horse-hairs dropped into water in time beget life and become worms or "snakes" prevails extensively over Europe as well as America. It is based on the fact that worms resembling short horse-hairs exist, and are not uncommon in placid pools. A contributor to the "Spectator" accounts for the experiences of persons who claim to have "seen" the horse-hairs become living, by observing that after lying in the water for a long time a hair swells, assumes the form of a young eel, and, in a way common to many inanimate substances, acquires a slow, wriggling motion.

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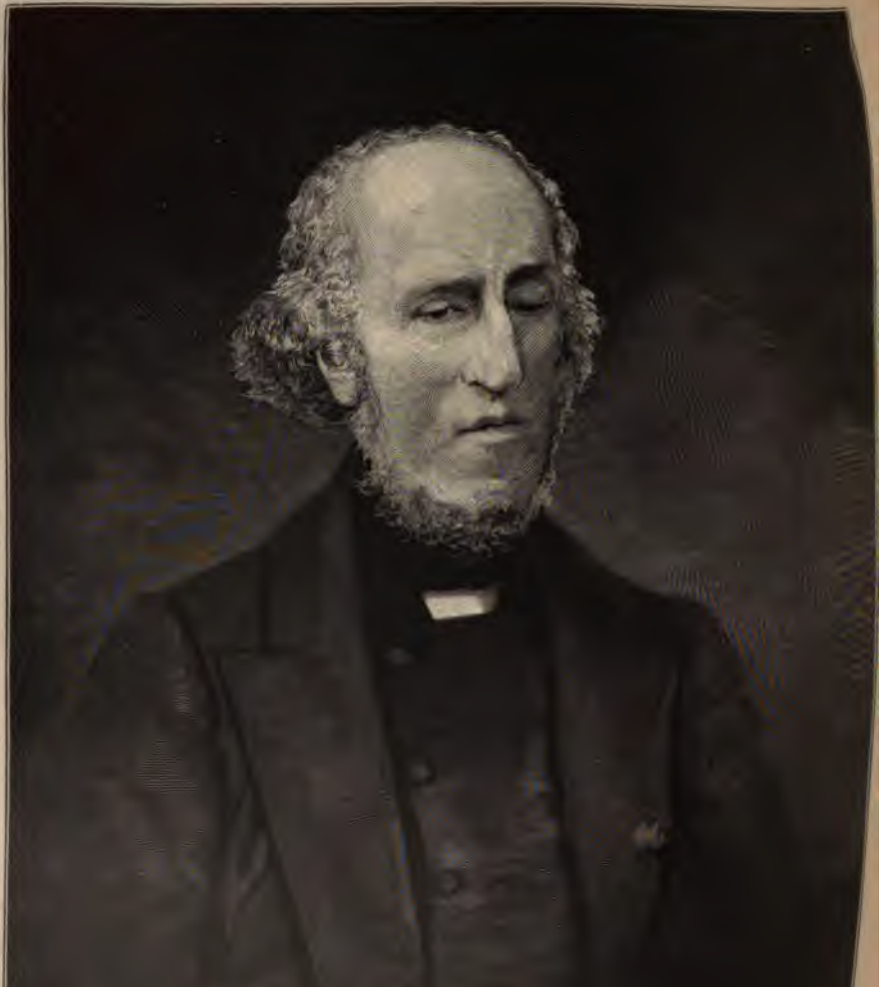

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NEW CHAPTERS IN THE WARFARE OF SCIENCE.

VII. COMPARATIVE MYTHOLOGY.

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PART II.

THE first effect of the Protestant Reformation was to popularize the older Dead Sea legends, and to make the public mind still more receptive for the newer ones.

Luther's great pictorial Bible, so powerful in fixing the ideas of the German people, showed by very striking engravings all three of these earlier myths—the destruction of the cities by fire from heaven, the transformation of Lot's wife, and the vile origin of the hated Moabites and Ammonites; and we find the salt statue, especially, in this and other pictorial Bibles, during generation after generation.

Catholic peoples also held their own in this display of faith. About 1517 François Regnault published at Paris a compilation on Palestine enriched with woodcuts; in this the old Dead Sea legend of the "Serpent Tyrus" reappears embellished, and with it various other new versions of old stories. Five years later Bartholomew de Salignac travels in the Holy Land, vouches for the continued existence of the Lot's wife statue, and gives new life to an old marvel by insisting that the sacred waters of the Jordan are not really poured into the infernal basin of the Dead Sea, but that they are miraculously absorbed by the earth.

These ideas were not confined to the people at large; we trace them among scholars.

In 1581 Bünting, a North German professor and theologian, published his "Itinerary of Holy Scripture," and in this the Dead Sea and Lot legends continue to increase. He tells us that the water of the sea "changes three times every day"; that it "spits forth fire"; that it throws up "on high" great foul masses which "burn like pitch" and "swim about like huge oxen"; that the statue of Lot's wife is still there, and that it shines like salt.

In 1590 Christian Adrichom, a Dutch theologian, published his famous work on sacred geography. He does not insist upon the Dead Sea legends generally, but declares that the statue of Lot's wife is still in existence, and on his map he gives a picture of her standing at Usdum.

Nor was it altogether safe to dissent from such beliefs. Just as, under the papal sway, men of science had been severely punished for wrong views of the physical geography of the earth in general, so, when Calvin decided to burn Servetus, he included in his indictment for heresy a charge that Servetus, in his edition of "Ptolemy," had made unorthodox statements regarding the physical geography of Palestine.*

So, too, Protestants and Catholics vied with each other in the making of new myths. Thus, in his "Most Devout Journey," published in 1608, Jean Zvallart, Mayor of Ath in Hainault, confesses himself troubled by conflicting stories about the salt statue, but declares himself sound in the faith that "some vestige of it still remains," and makes up for his bit of freethinking by adding a new mythical horror to the region—"crocodiles," which, with the serpents and the "foul odor of the sea," prevented his visit to the salt mountains.

In 1615 Father Jean Boucher publishes the first of many editions of his "Sacred Bouquet of the Holy Land." He depicts the horrors of the Dead Sea in a number of striking antitheses, and among these is the statement that it is made of mud rather than of water, that it soils whatever is put into it, and so corrupts the land about it that not a blade of grass grows in all that region.

In the same spirit thirteen years later, the Protestant Christopher Heidmann publishes his "Palæstina," in which he speaks of a fluid resembling blood oozing from the rocks about the Dead Sea, and cites authorities to prove that the statue of Lot's wife still exists and gives signs of life.

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* For biblical engravings of Lot's wife transformed into a salt statue, etc., see Luther's Bible, 1534, p. xi; also the pictorial "Electoral Bible"; also Merian's "Icones Biblicæ" of 1625; also the frontispiece of the Luther Bible published at Nuremberg in 1708; also Scheuchzer's "Kupfer Bibel," Augsburg, 1731, Tab. lxxx. For the account of the Dead Sea serpent "Tyrus," etc., see "Le Grand Voyage de Hierusalem," Paris (1517?), p. xxi. For De Salignac's assertion regarding the salt pillar and suggestion regarding the absorption of the Jordan before reaching the Dead Sea, see his "Itinerarium Sacræ Scripturæ," Magdeburg, 1593, §§ 34 and 35. For Bünting, see his "Itinerarium Sacræ Scripturæ," Magdeburg, 1589, pp. 78, 79. For Adrichom's picture of the salt statue, see map, p. 35, and text, p. 205, of his "Theatrum Terræ Sanctæ," 1613. For Calvin and Servetus, see *Willis*, "Servetus and Calvin," pp. 96 and 307; also the Servetus edition of Ptolemy.

Yet, as we near the end of the sixteenth century, some evidences of a healthful and fruitful skepticism begin to appear.

The old stream of travelers, commentators, and preachers, accepting tradition and repeating what they have been told, flows on; but here and there we are refreshed by the sight of a man who really begins to think and look for himself.

First among these is the French naturalist Pierre Bélon. As regards the ordinary wonders, he has the simple faith of his time. Among a multitude of similar things, he believed that he saw the stones on which the disciples were sleeping during the prayer of Christ, the stone on which the Lord sat when he raised Lazarus from the dead, the Lord's footprints on the stone from which he ascended into heaven, and, most curious of all, "the stone which the builders rejected." Yet he makes some advance on his predecessors, since he shows in one passage that he had thought out the process by which the simpler myths of Palestine were made. For, between Bethlehem and Jerusalem, he sees a field covered with small pebbles, and of these he says: "The common people tell you that a man was once sowing peas there, when Our Lady passed that way and asked him what he was doing; the man answered, 'I am sowing pebbles,' and straightway all the peas were changed into these little stones."

His ascribing belief in this explanatory transformation-myth to the "common people" marks the faint dawn of a new epoch.

Typical also of this new class is the German botanist Leonhard Rauwolf. He travels through Palestine in 1575, and, though devout and at times credulous, notes comparatively few of the old wonders, while he makes thoughtful and careful mention of things in nature that he really saw; he declines to use the eyes of the monks, and steadily uses his own to good purpose.

As we go on in the seventeenth century, this current of new thought is yet more evident; a habit of observing more carefully and of comparing observations had set in; the great voyages of discovery by Columbus, Vasco Da Gama, Magellan, and others were producing their effect, and this effect was increased by the inductive philosophy of Bacon, the reasonings of Descartes, and the suggestions of Montaigne.

So evident was this current that, as far back as the early days of the century, a great theologian, Quaresmio, of Lodi, had made up his mind to stop it forever. In 1616, therefore, he began his ponderous work entitled "The Historical, Theological, and Moral Explanation of the Holy Land." He labored upon it for nine years, gave nine years more to perfecting it, and then put it into the hands of the great publishing house of Plantin at Antwerp; they were four years in printing and correcting it, and, when it at last appeared, it seemed certain to establish the theological view of the Holy Land for all time. While taking abundant care of other myths which he believed sanctified by our sacred books, Quaresmio devoted himself at great length to the Dead Sea, but above all to the salt statue, and divides his chapter on it into three parts, each headed by a question: First, "*How* was Lot's wife changed into a statue of salt?" Secondly, "*Where* was she thus transformed?" And, thirdly, "*Does that statue still exist?*" Through each of these divisions he fights to the end against all who are inclined to swerve in the slightest degree from the orthodox opinion. He utterly refuses to compromise with any modern theorists. To all such he says, "The narration of Moses is historical and is to be received in its natural sense, and no right-thinking man will deny this." To those who favored the figurative interpretation he says, "With such reasonings any passage of Scripture can be denied."

As to the spot where the miracle occurred, he discusses four places, but settles upon the point where the picture of the statue is given in Adrichom's map. As to the continued existence of the statue, he plays with the opposing view as a cat fondles a mouse, and then shows that the most revered ancient authorities, venerable men still living, and the Bedouins, all agree that it is still in being. Throughout the whole chapter his thoroughness in scriptural knowledge and his profundity in logic are only excelled by his scorn for those theologians who were willing to yield anything to rationalism.

So powerful was this argument that it seemed to carry everything before it, not merely throughout the Roman obedience, but among the most eminent theologians of Protestantism.

As regards the Roman Church, we may take as a type the missionary priest Eugène Roger, who, shortly after the appearance of Quaresmio's book, published his own travels in Palestine. He was an observant man, and his work counts among those of real value; but the spirit of Quaresmio had taken possession of him fully. His work is prefaced with a map showing the points of most importance in scriptural history, and among these he identifies the place where Samson slew the thousand Philistines with the jaw-bone of an ass, and where he hid the gates of Gaza; the cavern which Adam and Eve inhabited after their expulsion from paradise; the spot where Balaam's ass spoke; the tree on which Absalom was hanged; the place where Jacob wrestled with the angel; the steep place where the swine possessed of devils plunged into the sea; the spot where the prophet Elijah was taken up in a chariot of fire; and, of course, the position of the salt statue which was once Lot's wife. He not only indicates places on land, but places in the sea; thus he shows where Jonah was swallowed by the whale, and "where St. Peter caught one hundred and fifty-three fishes."

As to the Dead Sea miracles generally, he does not dwell on them at great length; he evidently felt that Quaresmio had exhausted the subject, but he shows largely the fruits of Quaresmio's teaching in other matters. He sees, describes, and reasons with great theological acuteness upon the basilisk. The animal is about a foot and a half long, shaped like a crocodile, and kills people with its glance. The one which he saw was dead, fortunately for him, for in the time of Pope Leo IV, as he tells us, one appeared at Rome and killed many people by merely looking at them, but the Pope destroyed it with his prayers and the sign of the cross. He says that Providence has wisely and mercifully protected man by requiring the monster to cry aloud two or three times whenever he leaves his cavern, and the divine wisdom has also made it necessary that the monster should look his victim in the eye, and at a certain distance, in order that his glance may penetrate the victim's eye, and so pass at once to his heart. He also gives reason for supposing that the same divine mercy has provided that the crowing of a cock will kill a basilisk.

But even in this good and credulous missionary we see the influence of Bacon and the dawn of experimental science; for, having been told many stories regarding the salamander, he secured one, placed it alive upon the coals, and reports to us that the legends regarding its power to live in the fire are untrue. He also tried experiments with the chameleon, and found that the stories told regarding it were to be received with much allowance; but, while he uses his mind in these things after the modern method, he locks up his judgment when he discusses the letter of Scripture. A curious example of this we find in his reference to the famous text, in the thirty-eighth chapter of Ezekiel, which led the mediæval map-makers to place Jerusalem at the center of the earth. Coupling with this a text from Isaiah, he, by a theological argument, satisfies himself that the exact center of the earth is a certain spot marked on the pavement of the Church of the Holy Sepulchre: by a similar process of theological reasoning he also proves that the place where the Holy Cross stood was the identical spot first occupied by the tree which bore the forbidden fruit in the Garden of Eden.

So, too, we find the thoughts and words of Quaresmio echoing afar through the German universities, in public disquisitions, dissertations, and sermons. The great Bible commentators, both Catholic and Protestant, generally agreed in accepting them.

But, strong as this theological theory was, we find that, as time went on, it required to be braced somewhat, and in 1692 Wedelius, Professor of Medicine at Jena, chose as the subject of his inaugural address "The Physiology of the Destruction of Sodom and of the Statue of Salt."

It is a masterly example of "sanctified science." At great length he dwells on the characteristics of sulphur, salt, and thunderbolts; mixes up scriptural texts, theology, and chemistry after a most bewildering fashion; and finally comes to the conclusion that a thunderbolt, flung by the Almighty, calcined the body of Lot's wife, and at the same time vitrified its particles into a glassy mass looking like salt.*

By such demonstrations as these of Quaresmio and Wedelius the theological view of the myth seemed fastened upon the world forever.

Not only was this view demonstrated, so far as theologico-scientific reasoning could demonstrate anything, but it was clearly shown, by a continuous chain of testimony from the earliest ages, that the salt statue at Usdum had been recognized as the body of Lot's wife by Jews, Mohammedans, and the universal Christian Church, "always, everywhere, and by all."

Under the influence of teachings like these—and of the winter rains—new wonders began to appear at the salt pillar. In 1661 the Franciscan monk Zwinner published his travels in Palestine, and gave not only all the old myths regarding the salt statue, but a new one, in some respects more striking than any of the old—for he had heard that a dog, also transformed into salt, was standing by the side of Lot's wife.

Even the more solid Benedictine scholars were carried away, and we find in the "Sacred History" by Prof. Metzger, of the Order of St. Benedict, published in 1700, a renewal of the declaration that the salt statue must be a "*perpetual* memorial."

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* For Zvallart, see his "Très dévot Voyage à Ierusalem," Antwerp, 1608, book iv, chapter viii. His journey was made twenty years before. For Father Boucher, see his "Bouquet de la Terre Saincte," Paris, 1622, pp. 447, 448. For Heidmann, see his "Palæstina," 1689, pp. 58–62. For Bélon's credulity in matters referred to, see his "Observations de Plusieurs Singularitez," etc., Paris, 1553, pp. 141–144; and for the legend of the peas changed into pebbles, p. 145; see, also, Lartet in "De Luynes," iii, p. 11. For Rauwolf, see the "Reyssebuch," and Tobler, "Bibliographia." For a good account of the influence of Montaigne in developing French skepticism, see Prévost-Paradol's study on Montaigne prefixed to the Le Clerc edition of the "Essays," Paris, 1865; also the well-known passages in Lecky's "Rationalism in Europe." For Quaresmio I have consulted both the Plantin edition of 1639 and the superb new Venice edition of 1880–'82. The latter, though less prized by book fanciers, is the more valuable, since it contains some very interesting recent notes. For the above discussion see Plantin edition, vol. ii, pp. 758 *et seq.*, and Venice edition, vol. ii, pp. 572–574. As to the effect of Quaresmio on the Protestant Church, for Wedelius, see his "De Statua Salis," Jenæ, 1692, pp. 6, 7, and elsewhere. For Eugène Roger, see his "La Terre Saincte," Paris, 1664; the map showing various sites referred to is in the preface; and for basilisks, salamanders, etc., see pp. 89–92, 139, 218, and elsewhere. For thorough discussion of the Old Testament and mediæval view of Jerusalem as the center of the earth, see Eicken, "Geschichte und System der Mittelalterlicher Weltanschauung," Stuttgart, 1887, p. 622. See, also, on next page, legend that the grave of Adam was on Mount Calvary.

But it was soon evident that the scientific current was still working beneath this ponderous mass of theological authority. A typical evidence of this we find in 1666 in the travels of Doubdan, a canon of St. Denis. As to the Dead Sea, he says that he saw no smoke, no clouds, and no "black, sticky water"; as to the statue of Lot's wife, he says, "The moderns do not believe so easily that she has lasted so long"; then, as if alarmed at his own boldness, he concedes that the sea *may* be black and sticky *in the middle;* and from Lot's wife he escapes under cover of some pious generalities. Four years later another French ecclesiastic, Jacques Goujon, referring in his published travels to the legend of the salt pillar, says: "People may believe these stories as much as they choose; I did not see it, nor did I go there." So, too, in 1697, Morison, a dignitary of the French church, having traveled in Palestine, confesses that, as to the story of the pillar of salt, he has difficulty in believing it.

The same current is observed working still more strongly in the travels of the Rev. Henry Maundrell, an English chaplain at Aleppo, who traveled through Palestine during the same year. He pours contempt over the legends of the Dead Sea in general: as to the story that birds could not fly over it, he says that he saw them flying there; as to the utter absence of life in the sea, he saw small shells in it; he sees no traces of any buried cities; and, as to the stories regarding the statue of Lot's wife and the proposal to visit it, he says, "Nor could we give faith enough to these reports to induce us to go on such an errand."

The influence of the Baconian philosophy on his mind is very clear; for, in expressing his disbelief in the Dead Sea apples, with their contents of ashes, he says that he saw none, and he cites Lord Bacon in support of skepticism on this and similar points.

But the strongest effect of this growing skepticism is seen near the end of that century, when the eminent Dutch commentator Clericus published his commentary on the Pentateuch and his "Dissertation on the Statue of Salt."

At great length he brings all his shrewdness and learning to bear against the whole legend of the actual transformation of Lot's wife and the existence of the salt pillar, and ends by saying that "the whole story is due to the vanity of some and the credulity of more."

In the beginning of the eighteenth century we find new tributaries to this rivulet of scientific thought. In 1701 Father Félix Beaugrand dismisses the Dead Sea legends and the salt statue very curtly and dryly—expressing not his belief in it, but a conventional wish to believe.

In 1709 a scholar appeared in another part of Europe and of different faith, who did far more than any of his predecessors to envelop the Dead Sea legends in an atmosphere of truth—Adrian Reland, professor at the University of Utrecht. His work on Palestine is a monument of patient scholarship, having as its nucleus a love of truth as truth: there is no irreverence in him, but he quietly brushes away a great mass of myths and legends: as to the statue of Lot's wife, he does not deign to treat it at length, but incidentally applies the comparative method to it with killing effect, for he shows that the story of its miraculous renewal is but one among many of its kind.*

Yet to superficial observers the old current of myth and marvel seemed to flow into the eighteenth century as strong as ever, and of this we may take two typical evidences. The first of these is the "Pious Pilgrimage" of Vincent Briemle. His journey was made about 1710; and his work, brought out under the auspices of a high papal functionary some years later, in a heavy quarto, gave new life to the stories of the hellish character of the Dead Sea, and especially to the miraculous renewal of the salt statue.

In 1720 came a still more striking effort to maintain the old belief on the Protestant side, for, in that year the eminent theologian Masius published his great treatise on "The Conversion of Lot's Wife into a Statue of Salt."

He evidently intended that this work should be the last word on this subject among Protestants, as Quaresmio had imagined that his work would be the last among Catholics. He develops his subject after the high scholastic and theologic manner. Calling attention first to the divine command in the New Testament, "Remember Lot's wife," he argues through a long series of chapters. In the ninth of these he discusses "the *impelling cause*" of her looking back, and introduces us to the question, formerly so often discussed by theologians, whether the soul of Lot's wife was finally saved. Here we are glad to learn that the big, warm heart of Luther lifted him above the common herd of theologians, and led him to declare that she was "a faithful and saintly woman," and that she certainly was not eternally damned. In justice to the Roman Church also it should be said that several of her most eminent commentators took a similar view, and insisted that the sin of Lot's wife was venial, and therefore, at the worst, could only subject her to the fires of purgatory.

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* For Zwinner, see his "Blumenbuch des Heyligen Landes," München, 1661, p. 454. For Mezger, his "Sacra Historia," Augsburg, 1700, p. 30. For Doubdan, see his "Voyage de la Terre Sainte," Paris, 1666, pp. 338, 339; also Tobler and Gage's "Ritter." For Goujon, his "Histoire et Voiage de la Terre Saincte," Lyons, 1670, p. 230, etc. For Morison, see his "Voyage," book ii, pp. 516, 517. For Maundrell, see in Wright's "Collection," pp. 282 *et seq.* For Clericus, see his "Dissertatio de Salis Statua," in his "Pentateuch," edition of 1696, pp. 327 *et seq.* For Father Beaugrand, see his "Voyage," Paris, 1701, pp. 127 *et seq.* For Reland, see his "Palæstina," Traject. Batavorum, 1714, vol. i., pp. 61–254, and *passim.*

The eleventh chapter discusses at length the question *how* she was converted into salt, and, mentioning many theological opinions, dwells especially upon the view of Rivetus—that a thunderbolt, made up apparently of fire, sulphur, and salt, wrought her transformation at the same time that it blasted the land; and he bases this opinion upon the twenty-ninth chapter of Deuteronomy and the one hundred and seventh Psalm.

Later, there is presented a sacred scientific theory that "saline particles entered into her until her whole body was infected"; and with this Masius connects another piece of sanctified science, to the effect that "stagnant bile" may have rendered the surface of her body "entirely shining, bitter, dry, and deformed."

Finally, in the fourth division of the second section, he comes to the great question whether the salt pillar is still in existence. On this he is full and fair. On one hand he allows that Luther thought that it was involved in the general destruction of Sodom and Gomorrah, and he cites various travelers who had failed to find it; but, on the other hand, he gives a long chain of evidence to show that it continued to exist: very wisely he reminds the reader that the positive testimony of those who have seen it must outweigh the negative testimony of those who have not, and finally decides that the salt statue is still in being.

No doubt a work like this produced a considerable effect in Protestant countries; indeed, this effect seems evident as far off as England, for, in 1720, we find in Dean Prideaux's "Old and New Testament connected" a map on which the statue of salt is carefully indicated. So, too, in Holland, in the "Sacred Geography," published at Utrecht in 1758, by the theologian Bachiène, we find him, while showing many signs of rationalism, evidently inclined to the old views as to the existence of the salt pillar; but just here comes a curious evidence of the real direction of the current of thought through the century, for, nine years later, in the German translation of Bachiène's work we find copious notes by the translator in a far more rationalistic spirit; indeed, we see the dawn of the inevitable day of compromise, for we now have, instead of the old argument that the divine power by one miraculous act changed Lot's wife into a salt pillar, the suggestion that she was caught in a shower of sulphur and saltpeter, covered by it, and that the result was a lump, which, in a general way, is called in our sacred books "a pillar of salt."*

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* For Briemle, see his "Andächtige Pilgerfahrt," p. 129. For Masius, see his "De Uxore Lothi in Statuam Salis conversa," Hafniæ, 1720, especially pp. 29-31. For Dean Prideaux, see his "Old and New Testament connected in the History of the Jews," 1720,

But, from the middle of the eighteenth century, the new current sets through Palestine with ever-increasing strength. Very interesting is it to compare the great scriptural commentaries of the middle of this century with those published a century earlier.

Of the earlier ones we may take Matthew Poole's "Synopsis" as a type: as authorized by royal decree in 1667 it contains very substantial arguments for the pious belief in the statue. Of the later ones we may take the edition of the noted commentary of the Jesuit Tirinus seventy years later; while he feels bound to present the authorities, he evidently endeavors to get rid of the subject as speedily as possible under cover of conventionalities; of the spirit of Quaresmio he shows no trace.*

About 1760 came a striking evidence of the strength of this new current. The Abate Mariti then published his book upon the Holy Land; and, of this book by an Italian ecclesiastic, the most eminent of German bibliographers in this field says that it first broke a path for critical study of the Holy Land.

Mariti is entirely skeptical as to the sinking of the valley of Siddim and the overwhelming of the cities. He speaks kindly of a Capuchin Father who saw everywhere at the Dead Sea traces of the divine malediction, while he himself could not see them, and says, "It is because a Capuchin carries everywhere the five senses of faith, while I only carry those of nature." He speaks of "the lies of Josephus," and makes merry over "the rude and shapeless block" which the guide assured him was the statue of Lot's wife, explaining the want of human form in the salt pillar by telling him that this complete metamorphosis was part of her punishment.

About twenty years later another remarkable man broaches the subject in what was then known as the "philosophic" spirit —Volney. Between the years 1783 and 1785 he made an extensive journey through the Holy Land and published a volume of travels which by acuteness of thought and vigor of style secured general attention. In these, myth and legend were thrown aside, and we have an account simply dictated by the love of truth as truth. He, too, keeps the torch of science burning by applying his geological knowledge to the regions which he traverses.

As we look back over the eighteenth century we see mingled with the new current of thought, and strengthening it, a constantly increasing stream of more strictly scientific observation and reflection.

To review it briefly, in the very first years of the century Ma-

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map at page 7. For Bachiène, see his "Historische und geographische Beschreibung von Palæstina," Leipzig, 1766, vol. 1, pp. 118–120, and notes.

* For Poole, see "Poli Synopsis," 1669, p. 179; and for Tirinus, the Lyons' edition of his "Commentary," 1736, p. 10.

raldi showed the Paris Academy of Sciences fossil fishes found in the Lebanon region; a little later, Cornelius Bruyn, in the French edition of his Eastern travels, gave well-drawn representations of fossil fishes and shells, some of them from the region of the Dead Sea. About the middle of the century Richard Pococke, Bishop of Meath, and Korte, of Altona, made more statements of the same sort; and toward the close of the century, as we have seen, Volney gave still more of these researches, with philosophical deductions from them.

The result of all this was that there gradually dawned upon thinking men the conviction that, for ages before the appearance of man on the planet, and during all the period since his appearance, natural laws have been steadily in force, and in Palestine as elsewhere; this conviction obliged men to consider other than supernatural causes for the phenomena of the Dead Sea, and myth and marvel steadily shrank in value.

But at the very threshold of the nineteenth century Chateaubriand came into the field, and he seemed to banish the scientific spirit, though what he really did was to conceal it temporarily behind the vapors of his rhetoric. The time was propitious for him. It was the period of reaction after the French Revolution, when what was called religion was again in fashion, and when even atheists supported it as a good thing for common people; of such an epoch Chateaubriand, with his superficial information, thin sentiment, and showy verbiage, was the foreordained prophet. His enemies were wont to deny that he ever saw the Holy Land; whether he did or not, he added nothing to real knowledge, but simply threw a momentary glamour over the regions he described, and especially over the Dead Sea. The legend of Lot's wife he carefully avoided, for he knew too well the danger of ridicule in France.

As long as the Napoleonic and Bourbon reigns lasted, and indeed for some time afterward, this kind of dealing with the Holy Land was fashionable, and we have a long series of men, especially of Frenchmen, who evidently received their impulse from Chateaubriand.

About 1831 De Geramb, Abbot of La Trappe, evidently a very noble and devout spirit, sees vapor above the Dead Sea, but stretches the truth a little—speaking of it as "vapor or smoke." He could not find the salt statue, and complains of the "diversity of stories regarding it." The simple physical cause of this diversity—the washing out of different statues in different years—never occurs to him, but he comforts himself with the scriptural warrant for the metamorphosis.*

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* For Mariti, see his "Voyage," etc., vol. ii, pp. 352–356. For Tobler's high opinion of him, see the "Bibliographia," pp. 132, 133. For Volney, see his "Voyage en Syrie et

But to the honor of scientific men and scientific truth it should be said that even under Napoleon and the Bourbons there were men who continued to explore, observe, and describe with the simple love of truth as truth, and in spite of the probability that their researches would be received during their lifetime with contempt and even hostility both in church and state.

The pioneer in this work of the nineteenth century was the German naturalist Ulrich Seetzen. He began his main investigation in 1806, and soon his learning, courage, and honesty threw a flood of new light into the Dead Sea questions.

In this light, myth and legend faded more rapidly than ever. Typical of his method is his examination of the Dead Sea fruit. He found, on reaching Palestine, that Josephus's story regarding it, which had been accepted for nearly two thousand years, was believed on all sides; more than this, he found that the original myth had so grown that a multitude of respectable people at Bethlehem and elsewhere assured him that not only apples, but pears, pomegranates, figs, lemons, and many other fruits which grow upon the shores of the Dead Sea, though beautiful to look upon, were filled with ashes. These good people declared to Seetzen that they had seen these fruits, and that, not long before, a basketful of them which had been sent to a merchant of Jaffa had turned to ashes.

Seetzen was evidently perplexed by this mass of testimony, and naturally anxious to examine these fruits. On arriving at the sea he began to look for them, and the guide soon showed him the "apples." These he found to be simply an *asclepia*, which had been described by Linnæus, and which is found in the East Indies, Arabia, Egypt, Jamaica, and elsewhere; the "ashes" were simply seeds. He looked next for the other fruits, and the guide soon found for him the "lemons"; these he discovered to be a species of *solanum* found in other parts of Palestine and elsewhere, and the seeds in these were the famous "cinders." He looked next for the pears, figs, and other accursed fruits; but, instead of finding them filled with ashes and cinders, he found them like the same fruits in other lands, and he tells us that he ate the figs with much pleasure.

So perished a myth which had been kept alive two thousand years, partly by modes of thought natural to theologians, partly by the self-interest of guides, and partly by the love of marvel-mongering among travelers.

Egypte," Paris, 1807, i, 308 *et seq.*; also, for a statement of contributions of the eighteenth century to geology, Lartet in De Luynes's "Mer Morte," vol. iii, p. 12. For Cornelius Bruyn, see French edition of his works, 1714, in which his name is given as "Le Brun," especially for representations of fossils, pp. 309 and 375. For Chateaubriand, see his "Voyage," etc., vol. ii, part iii. For De Geramb, see his "Voyage," ii, 45–47.

The other myths fared no better. As to the appearance of the sea, he found its waters not "black and sticky," but blue and transparent; he found no smoke rising from the abyss, but tells us that sunlight and cloud and shore were pleasantly reflected from the surface. As to Lot's wife, he found no salt pillar which had been a careless woman, but the Arabs showed him many bowlders which had once been wicked men.

His work was worthily continued by a long succession of true and reverent men, among them such travelers or geographers as Burckhardt, Irby, Mangles, Fallmerayer, and Carl von Raumer: by men like these the atmosphere of myth and legend was steadily cleared away; as a rule, they simply forgot Lot's wife altogether.

Greatest of all in this noble succession was an American theologian, Dr. Edward Robinson, professor at New York, a man of whom his country and humanity may well be proud.

Beginning about 1826, he devoted himself for thirty years to the thorough study of the geography of Palestine, and he found a worthy coadjutor in another American divine, Dr. Eli Smith. Neither of these men departed openly from the old traditions; that would have cost a heart-breaking price, the loss of all further opportunity to carry on their researches. Robinson did not even think it best to call attention to the mythical character of much on which his predecessors had insisted; he simply brought in, more and more, the dry, clear atmosphere of the love of truth for truth's sake, and, in this, myths and legends steadily disappeared.

By doing this he rendered a far greater service to real Christianity than any other theologian had ever done in this field.

Very characteristic is his dealing with the myth of Lot's wife. Though more than once at Usdum, though giving valuable information regarding the sea, shore, and mountains there, he carefully avoids all mention of the salt pillar and of the legend which arose from it. In this he set an example followed by most of the more thoughtful religious travelers since his time. Very significant is it to see the New Testament injunction, "Remember Lot's wife," so utterly forgotten. These later investigators seem never to have heard of it, and this constant forgetfulness shows the change which had taken place in the enlightened thinking of the world.

But in the year 1848 came an episode very striking in its character and effect.

At that time, the war between the United States and Mexico having closed, Lieutenant Lynch, of the United States Navy, found himself in the port of Vera Cruz, commanding an old hulk, the Supply. Looking about for something to do, it occurred to him to write to the Secretary of the Navy asking permission to explore the Dead Sea. Under ordinary circumstances the proposal would doubtless have been strangled with red tape; but fortunately the Secretary at that time was Mr. John Y. Mason, of Virginia. Mr. Mason was famous for his good nature: both at Washington and at Paris, where he was afterward minister, this predominant trait has left a multitude of amusing traditions; it was of him that Thomas Benton said, "To be supremely happy he must have his paunch full of oysters and his hands full of cards."

The Secretary granted permission, but evidently gave the matter not another thought. As a result, came an expedition the most comical and one of the most rich in results to be found in American annals. Never was anything so happy-go-lucky. Lieutenant Lynch started with his hulk, with hardly an instrument save those ordinarily found on shipboard, and with a body of men probably the most unfit for anything like scientific investigation ever sent on such an errand; fortunately, he picked up a young instructor in mathematics, Mr. Anderson, and added to his apparatus two strong iron boats.

Arriving, after a tedious voyage, on the coast of Asia Minor, he set at work. He had no adequate preparation in general history, archæology, or the physical sciences, but he had his American patriotism, energy, pluck, pride, and devotion to duty, and these qualities stood him in good stead. With great labor he got the iron boats across the country. Then the tug of war began. First of all investigators, he forced his way through the whole length of the river Jordan and from end to end of the Dead Sea. There were constant difficulties, geographical, climatic, and personal, but Lynch cut through them all. He was brave or shrewd, as there was need. Anderson proved an admirable helper, and together they made surveys of distances, altitudes, depths, and sundry simple investigations in a geological, mineralogical, and chemical way. Much was poorly done, much was left undone, but the general result was most honorable both to Lynch and Anderson, and Secretary Mason found that his easy-going patronage of the enterprise was the best act of his official life.

The results of this expedition on public opinion were most curious. Lynch was no scholar in any sense; he had traveled little, and thought less on the real questions underlying the whole investigation; as to the difference in depth of the two parts of the lake, he jumped—with a sailor's disregard of logic—to the conclusion that it somehow proved the mythical account of the overwhelming of the cities, and he indulges in reflections of a sort probably suggested by his recollections of American Sunday schools.

Especially noteworthy is his treatment of the legend of Lot's wife. He found the pillar of salt. It happened to be at that period a circular column of friable salt rock, about forty feet high; yet, while he accepts every other old myth, he declares the belief that this was once the wife of Lot "a superstition."

One little circumstance added enormously to the influence of this book, for, as a frontispiece, he inserted a picture of the salt column. It was delineated in rather a poetic manner; light streamed upon it, heavy clouds hung above it, and as a background were ranged buttresses of salt rock, furrowed and channeled out by the winter rains: this salt statue picture was spread far and wide, and in thousands of country pulpits and Sunday schools it was shown as a tribute of science to Scripture.

Nor was this influence confined to American Sunday-school children, for Lynch had innocently set a trap into which several European theologians stumbled. One of these was Dr. Lorenz Gratz, Vicar-General of Augsburg, a theological professor. In the second edition of his "Theatre of the Holy Scriptures," published in 1858, he hails Lynch's discovery of the salt pillar with joy; forgets his allusion to the old theory regarding it as a superstition; and does not stop to learn that this was one of a succession of statues washed out yearly by the rains, but accepts it as the original Lot's wife.

The French churchmen suffered most. About two years after Lynch, De Saulcy visits the Dead Sea to explore it thoroughly, evidently in the interest of sacred science—and of his own promotion. Of the modest thoroughness of Robinson there is no trace in his writings. He promptly discovered the overwhelmed cities, which no one before or since has ever found, poured contempt on other investigators, and threw over his whole work an air of piety. But, unfortunately, having a Frenchman's dread of ridicule, he attempted to give a rationalistic explanation of what he calls "the enormous needles of salt washed out by the winter rain," and their connection with the Lot's wife myth, and declared his firm belief that she, "being delayed by curiosity or terror, was crushed by a rock which rolled down from the mountain, and when Lot and his children turned about they saw at the place where she had been only the rock of salt which covered her body."

But this would not do at all, and an eminent ecclesiastic privately and publicly expostulated with De Saulcy—very naturally declaring that "it was not Lot who wrote the book of Genesis."

The result was that another edition of De Saulcy's work was published by a Church Book Society, with the offending passage omitted; but a passage was retained really far more suggestive of heterodoxy, and this was an Arab legend accounting for the origin of certain rocks near the Dead Sea curiously resembling salt formations; this in effect ran as follows:

"Abraham, the friend of God, having come here one day with his mule to buy salt, the salt-workers impudently told him that they had no salt to sell, whereupon the patriarch said: 'Your words are true; you have no salt to sell,' and instantly the salt of this whole region was transformed into stone, or rather into a salt which has lost its savor."

Nothing could be more sure than this story to throw light into the mental and moral process by which the salt pillar myth was originally created.

In the years 1864 and 1865 came an expedition on a much more imposing scale—that of the Duc de Luynes. His knowledge of archæology and his wealth were freely devoted to working the mine which Lynch had opened, and, taking with him an iron vessel and several *savants*, he devoted himself especially to finding the cities of the Dead Sea, and to giving less vague accounts of them than those of De Saulcy. But he was disappointed, and honest enough to confess his disappointment. So vanished one of the most cherished parts of the legend.

But worse remained behind. In the orthodox duke's company was an acute geologist, Monsieur Lartet, who in due time made an elaborate report, which let a flood of light in upon the whole region.

The Abbé Richard had been rejoicing the orthodox heart of France by exhibiting some prehistoric flint implements as the knives which Joshua had made for circumcision. By a truthful statement Monsieur Lartet set all France laughing at him, and then turned to the geology of the Dead Sea basin. While he conceded that man may have seen some volcanic crisis there toward its end, and may have preserved a vivid remembrance of the vapor then rising, his whole argument showed irresistibly that all the phenomena of the region are due to natural causes, and that so far from a sudden rising of the lake above the valley within historic times, it has been for ages steadily subsiding.

Since Balaam was called by Balak to curse his enemies, and "blessed them altogether," there has never been a more unexpected tribute to truth.

Even the salt pillar at Usdum, as depicted in Lynch's book, aided to undermine the myth among thinking men, for the background of the picture showed them other pillars of salt in process of formation; and the ultimate result of all these expeditions of the century was to spread an atmosphere in which myth and legend became more and more attenuated.

To sum up the main points in this work of the nineteenth century, Seetzen, Robinson, and others had found that a human being could traverse the lake without being killed by hellish smoke; that the water gave forth no odors; that the fruits of the region were not created full of cinders to match the desolation of the Dead Sea, but were growths not uncommon in Asia Minor and elsewhere; in fact, that all the phenomena were due to natural causes.

Ritter and others had shown that all noted features of the Dead Sea and the surrounding country were to be found in various other lakes and regions, to which no supernatural cause was ascribed among enlightened men. Lynch, Van de Velde, Osborne, and others had revealed the fact that the "pillar of salt" was frequently formed anew by the rains; and Lartet and other geologists had given a final blow to the myths by making it clear from the markings on the neighboring rocks that, instead of a sudden upheaval of the sea above the valley of Siddim, there had been a gradual subsidence for ages.*

Even before all this evidence was in, a judicial decision had been pronounced upon the whole question by an authority both Christian and scientific, from which there could be no appeal. During the second quarter of the century Prof. Carl Ritter, of the University of Berlin, began giving to the world those researches which have placed him at the head of all geographers ancient or modern, and finally he brought together those relating to the geography of the Holy Land, publishing them as part of his great work on the physical geography of the earth. He was a Christian, and nothing could be more reverent than his treatment of the whole subject; but his German honesty did not permit him to conceal the truth, and he simply classed together all the stories of the Dead Sea—old and new—no matter where found, whether in the sacred books of Jews, Christians, or Mohammedans; whether in lives of saints or accounts of travelers, as "myths" and "sagas."

From this decision there has never been among intelligent men any appeal.

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* For Seetzen, see his "Reisen," edited by Kruse, Berlin, 1854–'59; for the "Dead Sea Fruits," vol. ii, p. 231 *et seq.*; for the appearance of the sea, etc., p. 243, and elsewhere; for the Arab transformation explanatory legends, vol. iii, pp. 7, 14, 17. As to similarity of the "pillars of salt" to columns washed out by rains elsewhere, see Kruse's "Commentary" in vol. iv, p. 240; also Fallmerayer, i, 197. For Irby and Mangles, see work already cited. For Robinson, see his "Biblical Researches," London, 1841; also his "Later Biblical Researches," London, 1856. For Lynch, see his "Narrative," London, 1849. For Gratz, see his "Schauplatz der Heyl. Schrift.," pp. 186, 187. For De Saulcy, see his "Voyage autour de la Mer Morte," Paris, 1853, especially vol. i, p. 252, and his journal of early months of 1851, in vol. ii, comparing with it his work with the same title published in 1858 in the "Bibliothèque Catholique de Voyages et Romans," vol. i, pp. 78–81. For Lartet, see his papers read before Geographical Society at Paris; also citations in Robinson; but, above all, his elaborate reports which form the greater part of the second and third volumes of the monumental work which bears the name of De Luynes, already cited. For exposures of De Saulcy's credulity and errors, see Van de Velde, "Syria and Palestine," *passim*; also Canon Tristram's "Land of Israel"; also De Luynes, *passim*.

The adjustment of recent orthodox thought to this view presents some curious features. As typical we may take the travels of two German theologians between 1860 and 1870—John Kränzel, pastor in Munich; and Peter Schegg, lately professor in the university of that city.

The archdiocese of Munich-Freising is one of those in which the attempt to oppress modern scientific thought has been most steadily carried on. Its archbishops have constantly shown themselves assiduous in securing cardinals' hats by thwarting science and by stupefying education. The twin towers of the old cathedral of Munich have seemed to throw a killing shadow over intellectual development in that region. Naturally, then, these two clerical travelers from that diocese did not commit themselves to clearing away any of the Dead Sea myths; but it is significant that neither of them follows the example of so many of their clerical predecessors in defending the salt-pillar legend; they steadily avoid it altogether.

The more recent history of the salt pillar, since Lynch, deserves mention. It appears that the travelers immediately after him found it shaped by the storms into a spire; that a year or two later it had utterly disappeared; and about the year 1870 Prof. Palmer on visiting the place found at some distance from the main salt bed, as he says, "a tall, isolated needle of salt or salt rock, which does really bear a curious resemblance to an Arab woman with a child on her shoulders."

Three years later Smith's "Dictionary of the Bible," makes its concession to the old belief regarding Sodom and Gomorrah as slight as possible, and the myth of Lot's wife entirely disappears.

The theological effort to compromise with science now came in more strongly than ever. This effort had been made long before: as we have seen, it had begun to show itself decidedly as soon as the influence of the Baconian philosophy was felt. Clerc thought that the shock caused by the sight of fire from heaven killed Lot's wife instantly and made her body rigid as a statue. Eichhorn suggested that she fell into a stream of melted bitumen. Michaelis suggested that her relatives raised a monument of salt rock to her memory. Friedrichs suggested that she fell into the sea, and that the salt stiffened around her clothing, thus making a statue of her. Some claimed that a shower of sulphur came down upon her, and that the word which has been translated "salt" could possibly be translated "sulphur." Others hinted that the salt by its antiseptic qualities preserved her body as a mummy. De Saulcy, as we have seen, thought that a piece of salt rock fell upon her; and very recently Principal Dawson ventures the explanation that a flood of salt mud coming from a volcano incrusted her.

But theologians themselves were the first to show the inadequacy of these explanations. The more rationalistic pointed out the fact that they were contrary to the sacred text: Von Bohlen, an eminent professor at Königsberg, in his sturdy German honesty, declared that the salt pillar gave rise to the story, and compared the pillar of salt causing this transformation legend to the rock in Greek mythology which gave rise to the transformation legend of Niobe.

On the other hand, the more severely orthodox protested against such attempts to explain away the clear statements of Holy Writ. Dom Calmet, while presenting many of these explanations made as early as his time, gives us to understand that nearly all theologians adhered to the idea that Lot's wife was instantly and really changed into salt; and in our own time, as we shall presently see, have come some very vigorous protests.

Similar attempts were made to explain the other ancient legends regarding the Dead Sea. One of the most recent of these is that the cities of the plain, having been built with blocks of bituminous rock, were set on fire by lightning, a contemporary earthquake helping on the work. Still another is that accumulations of petroleum and inflammable gas escaped through a fissure, took fire, and so produced the catastrophe.*

Against this sort of rationalism perhaps the most vigorous of recent protests appeared in 1876, in an edition of Monseigneur Mislin's work on "The Holy Places." In order to give weight to the book, he spread his qualities at great length on the title-page. Among other things, he was prelate of the papal household, apostolic prothonotary, a doctor of theology and of philosophy, and his work is prefaced by letters from Pope Pius IX and sundry high ecclesiastics—and from Alexandre Dumas. His hatred of Protestant missionaries in the East is phenomenal; he calls them "bagmen," ascribing all mischief and infamy to them; and his hatred is only exceeded by his credulity. He cites all the arguments in favor of the salt statue at Usdum as the identical one into which Lot's wife was changed, adds some of his own, and presents her as "a type of doubt and heresy." With the proverbial facility of theologians in translating any word of a dead language into anything that suits their purpose, he says that the word in the nineteenth chapter of Genesis, which is translated "statue" or "pillar," may be translated "eternal monument"; he is especially severe on poor Monsieur De Saulcy for thinking that Lot's wife was killed by the falling of a piece of salt rock, and actually boasts that it was he who caused De Saulcy, a member of the French Institute, to suppress the obnoxious passage in a later edition.

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* For Kränzel, see his "Reise nach Jerusalem," etc.; for Schegg, his "Gedenkbuch einer Pilgerreise," etc., 1867, chapter xxiv. For Palmer, see his "Desert of the Exodus," vol. ii, pp. 478, 479. For the various compromises, see works already cited, *passim*. For Von Bohlen, see his "Genesis," Königsberg, 1835, pp. 200–213. For Calmet, see his "Dictionarium," etc., Venet., 1766. For very recent compromises, see J. W. Dawson and Dr. Cunningham Geikie in works cited.

Nor did such rationalizing efforts fare much better among Protestant theologians. In his excellent work on "The Land of Israel," Canon Tristram makes an energetic protest against scientific explanations of biblical statements.

Between 1870 and 1880 came two killing blows at the older theories, and they were dealt by two American scholars of the highest character. First of these may be mentioned Dr. Philip Schaff, a professor in the Presbyterian Theological Seminary at New York, who published his travels in 1877. In a high degree he united the scientific with the religious spirit, but the trait which made him especially fit for dealing with this subject was his straightforward German honesty. He tells the simple truth regarding the pillar of salt, so far as its physical origin and characteristics are concerned, and leaves his reader to draw the natural inference as to its relation to the myth. With the fate of Dr. Robertson Smith in Scotland and Dr. Woodrow in South Carolina before him—both recently driven from their professorships for truth-telling—Dr. Schaff deserves honor for telling as much as he does.

Similar in effect, and even more bold in statement, were the "Travels" of the Rev. Henry Osborne, published in 1878. In a truly scientific spirit he calls attention to the similarity between the Dead Sea, with the river Jordan, to sundry other lake and river systems; he points out the endless variations between writers describing the salt formations at Usdum; accounts rationally for these variations, and quotes from Dr. Anderson's report, saying, "From the soluble nature of the salt and the crumbling looseness of the marl, it might be well imagined that, while some of these needles are in process of formation, others are being washed away."

Thus came out, little by little, the truth regarding the Dead Sea myths, and especially the salt pillar at Usdum; but the final truth remained to be told, and now one of the purest men and truest divines of this century told it. Arthur Stanley, Dean of Westminster, visiting the country and thoroughly exploring it, allowed that the physical features of the Dead Sea and its shores suggested the myths and legends, and he sums up the whole as follows: "A great mass of legends and exaggerations, partly the cause and partly the result of the old belief that the cities were buried under the Dead Sea, has been gradually removed in recent years."

So, too, about the same time, Dr. Conrad Furrer, pastor of the great church of St. Peter at Zürich, gave to the world a book of travels reverent and thoughtful, and, in this, honestly acknowledged that the needles of salt at the southern end of the Dead Sea "in primitive times gave rise to the tradition that Lot's wife was transformed into a statue of salt." Thus was the mythical character of this story at last openly confessed by leading churchmen on both continents.

Plain statements like these from such sources left the high theological position more difficult than ever, and now a new compromise was attempted. As the Siberian mother tried to save her best-beloved child from the pursuing wolves by throwing over to them her less favored children, so an effort was now made in a leading commentary to save the legends of the valley of Siddim and the miraculous destruction of the cities by throwing overboard the legend of Lot's wife.*

But even this utterly failed, for there soon followed the worst blows of all. First, from Van de Velde, who made his journey in 1851 and 1852. He is a most devout man, but he confesses that the volcanic action at the Dead Sea must have been far earlier than the catastrophe mentioned in our sacred books, and that "the overthrow of Sodom and Gomorrah had nothing to do with this." A few years later a very eminent dignitary of the English Church, Canon Tristram, doctor of divinity and fellow of the Royal Society, who had explored the Holy Land thoroughly, after some generalities about miracles, gave up the whole attempt to make science agree with the myths, and used these words: "It has been frequently assumed that the district of Usdum and its sister cities was the result of some tremendous geological catastrophe. . . . Now, careful examination by competent geologists, such as Monsieur Lartet and others, has shown that the whole district has assumed its present shape slowly and gradually through a succession of ages, and that its peculiar phenomena are similar to those of other lakes." So sank from view the whole mass of Dead Sea myths and legends, and science gained a victory both for geology and comparative mythology.

An amusing result has followed this development of opinion. As we have already seen, traveler after traveler, Catholic and Protestant, now visits the Dead Sea, and hardly one of them follows the New Testament injunction to "remember Lot's wife." Nearly every one of them seems to think it best to forget her.

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* For Mislin, see his "Les Saints Lieux," Paris, 1876, vol. iii, pp. 290–293, especially note at foot of page 292. For Schaff, see his "Through Bible Lands," especially chapter xxix. See also Rev. H. S. Osborne, M. A., "Travels," etc., pp. 267 *et seq.*; also Stanley's "Sinai and Palestine," London, 1887, especially pp. 290–293. For Furrer, see his "En Palestine," Geneva, 1886, vol. i, p. 246. For the attempt to save one legend by throwing overboard the other, see Keil und Delitsch, "Biblischer Commentar ueber das Alte Testament," vol. i, pp. 185, 186. For Van de Velde, see his "Syria and Palestine," vol. ii, p. 120.

Of the great mass of pious legends they are shy enough, but that of Lot's wife, as a rule, they seem never to have heard of, and, if they do allude to it, they simply cover the whole subject with a haze of conventionality and sacred rhetoric.[*]

Naturally, under this state of things, there has followed the usual attempt to throw off from Christendom the responsibility of the old belief, and in 1887 came a curious effort of this sort. In that year appeared the Rev. Dr. Cunningham Geikie's valuable work on "The Holy Land and the Bible." In it he makes the following statement as to the salt formation at Usdum: "Here and there, hardened portions of salt, withstanding the water, while all around them melts and wears off, rise up isolated pillars, one of which bears among the Arabs the name of Lot's wife."

In the light of the previous history, there is something at once pathetic and comical in this attempt to throw the myth upon the shoulders of the poor Arabs. The myth was not originated by Mohammedans; it appears, as we have seen, first among the Jews, and, I need hardly remind the reader, comes out in the Book of Wisdom and in Josephus, and has been steadily maintained by fathers, martyrs, and doctors of the Church, by at least one pope, and by innumerable bishops, priests, monks, commentators, and travelers, Catholic and Protestant, ever since. In thus throwing the responsibility of the myth upon the Arabs Dr. Geikie appears to show both the "perfervid genius" of his countrymen and their incapacity to recognize a joke.

Nor is he more happy in his rationalistic explanations of the whole mass of myths. He supposes a terrific storm, in which the lightning kindled the combustible materials of the cities, aided perhaps by an earthquake; but this shows a disposition to break away from the exact statements of the sacred books which would have been most severely condemned by the universal Church during at least eighteen hundred years of its history. Nor would the explanations of Sir William Dawson have fared any better: it is very doubtful whether either of them could escape unscathed to-day from a synod of the Free Church of Scotland, or of any of the leading orthodox bodies in the Southern States of the American Union.[†]

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[*] The only notice of the Lot's wife legend in the editions of Robinson at my command is a very curious one by Leopold von Buch, the eminent geologist. Robinson, with a fearlessness which does him credit, consulted Von Buch, who in his answer was evidently inclined to make things easy for Robinson by hinting that Lot was so much struck with the salt formations that he *imagined* that his wife had been changed into salt. On this theory Robinson makes no comment. See Robinson, "Biblical Researches in Palestine," etc., London, 1841, vol. ii, p. 674.

[†] For these most recent explanations, see Rev. Cunningham Geikie, D. D., in work cited; also Sir J. W. Dawson, "Egypt and Syria," published by the Religious Tract Society, 1887, *pp.* 125, 126.

How unsatisfactory all such rationalism must be to a truly theological mind is seen not only in the dealings with Prof. Robertson Smith in Scotland and Prof. Woodrow in South Carolina, but, most clearly, in a book published in 1886 by Monseigneur Hausman de Wandelbourg. This work appeared in two ponderous volumes and with a great flourish of trumpets. To the name of the author was attached a long list of titles: among other things, he is Prelate of the Pope's Household, a Mitred Abbot, Canon of the Holy Sepulchre, and a Doctor of Theology of the Pontifical University at Rome, and the work is introduced by approving letters from Pope Leo XIII and the Patriarch of Jerusalem. Monseigneur de Wandelbourg scorns the idea that the salt column at Usdum is not the statue of Lot's wife; he points out not only the danger of yielding this evidence of miracle to rationalism, but the fact that the divinely inspired authority of the Book of Wisdom, written, at the latest, two hundred and fifty years before Christ, distinctly refers to it. He summons Josephus as a witness. He dwells on the fact that Pope St. Clement, Irenæus, Hegesippus, and St. Cyril, "who as Bishop of Jerusalem must have known better than any other person what existed in Palestine," with St. Jerome, St. Chrysostom, and a multitude of others, attest as a matter of their own knowledge or of popular notoriety that the remains of Lot's wife really existed in their time in the form of a column of salt; and he points triumphantly to the fact that Lieutenant Lynch found this very column.

In the presence of such a continuous line of witnesses, some of them divinely inspired, and all of them greatly revered—a line extending through thirty-seven hundred years—he condemns most vigorously all those who do not believe that the pillar of salt now at Usdum is identical with the wife of Lot, and stigmatizes them as people who "do not wish to believe the truth of the word of God." His ignorance of many of the simplest facts bearing upon the legend is very striking, yet he does not hesitate to speak of men who know far more and have thought far more upon the subject as "grossly ignorant." The most laughable feature in his ignorance is the fact that he is utterly unaware of the annual changes in the salt statue. He is entirely ignorant of such facts as that the priest Gabriel Giraudet in the sixteenth century found the statue lying down; that the monk Zwinner found it in the seventeenth century standing, and accompanied by a dog also transformed into salt; that Prince Radziwill found no statue at all; that the pious Vincent Briemle in the eighteenth century found the monument renewing itself; that about the middle of the nineteenth century Lynch found it in the shape of a tower or column forty feet high; that within two years afterward De Saulcy found it washed into the form of a spire; that a year later Van de Velde found it utterly washed away; and that a few years later Palmer found there "a statue bearing a striking resemblance to an Arab woman with a child in her arms." Thus ended the last great demonstration thus far on the side of sacred science—the last retreating shot from the theological rear-guard.

It is but just to say that a very great share in the honor of the victory of science in this field is due to men trained as theologians. It would naturally be so, since few others have devoted themselves to direct labor in it; yet great honor is none the less due to such men as Reland, Mariti, Robinson, Smith, Schaff, Stanley, and Tristram.

They have rendered even a greater service to religion than to science, for they have made a beginning, at least, of doing away with that enforced belief in myths as history which has become a most serious danger to Christianity.

For the worst enemy of Christianity could wish nothing more than that its main leaders should prove or insist that it can not be adopted save by those who accept, as historical, statements which enlightened men throughout the world know to be mythical. The result of such a demonstration would only be more and more to make thinking people inside the church dissemblers, and thinking people outside, scoffers.

Far better is it to welcome the aid of science, in the conviction that all truth is one, and, in the light of this truth, to allow theology and science to work together in the steady evolution of religion and morality.

The revelations made by the sciences which most directly deal with the history of man all converge in the truth that during the earlier stages of this evolution moral and spiritual teachings must be inclosed in myth, legend, and parable. "The Master" felt this when he gave to the poor peasants about him—and so to the world—his simple and beautiful illustrations. In making this truth clear, science will give to religion far more than it will take away, for it will throw new life and light into all sacred literature.

THE origin of the Malays is traced by Dr. B. Hagen to the highlands of west Sumatra, whence the peoples extended slowly eastward; the first movement being probably by the races that are now to be found only in the interior of the great islands. These "aborigines" of the islands crushed out a population already in possession, as remains of which the negritos may be taken. The Malays in the narrower sense occupying Sumatra, Malacca, and north Borneo, are to be regarded as the last emigration from this center, which occurred between the twelfth and fifteenth centuries A. D. Crosses and mixtures arose with the Indians and Chinese, who have been long in intercourse with the archipelago, and in less measure also with the Arabs. For this reason we must not expect to find the pure racial type, *especially not* in the coast population.

THE MISSION OF EDUCATED WOMEN.

By Mrs. M. F. Armstrong.

"Love seldom haunts the breast
Where learning lies."—Pope.

"'Tis Reason's part,
To govern and to guard the heart."—Cotton.

"I loved her well; I would have loved her better
Had love been met with love;
As 'tis, I leave her
To brighter destinies, if so she deems them."—Byron.

AN article entitled "Plain Words on the Woman Question," reprinted from the "Fortnightly Review" in this magazine, is so far in the nature of an attack upon the women whom the writer calls into court as to make reply, from one or another quarter, legitimate, and indeed, I think, obligatory. As a woman, who is bound by the conditions of wife and motherhood, for which Mr. Allen makes so able a plea, I can not individually appear on either side. It is not the women whom I represent who are under discussion, but none the less are the principles involved of the deepest and most pressing interest to thoughtful women everywhere, whether they have elected the single-handed fight, or the less evident but none the less serious test which comes with motherhood and the endeavor to make a home.

My excuse, therefore, for offering myself, in a sense, as a mouthpiece for the women whom Mr. Allen classifies as "deplorable accidents" is, first, that the points raised are in reality of as much importance to married women as to their unmarried sisters; and, second, that my position gives me, I think, unusual advantages for getting at certain underlying facts.

I have been for years connected with a large educational institution, where young men and women are working, side by side, under identically similar influences. The officials and teachers in this school are largely women, and women who, to quote Mr. Allen, have become "traitors to their sex," in that they have taken upon their shoulders the burden of their own support. They are, with few exceptions, highly educated, many of them college-bred, three among them being regular physicians, while all of them, if I may be permitted to judge, are of at least average attractiveness. As to health, social position, and previous condition, they offer also, I believe, a fair average, while their intellectual standards mark them high in the scale of feminine development.

For years they have puzzled me, for they are, without doubt, representative of a social phase, and the reasons for their existence, as well as the future to which they point, offer a unique temptation to the theorist. The appearance of the article already alluded to gave me a long-desired opportunity, and I at once laid it before my friends, asking for it their serious consideration. Nowhere in America, I am sure, could the opportunity be more complete, or the response more telling; and I trust that what these women have to say for themselves will not be without interest, to those at least who have read Mr. Allen's frank and, on the whole, liberal article.

In a charming cottage, occupied by two of this misguided sisterhood, to whose *ménage* the most critical eye could find nothing lacking, there was gathered, a week or two since, an unmistakably striking assemblage of single women, well looking, well dressed, ranging from twenty to fifty years of age, every one of whom could have, in the past, married, or could still marry, were it her desire to do so.

There was not a fanatic among them; they were sensible, earnest, in some cases brilliant women, who had, with more or less intention, turned their backs upon marriage, and chosen instead lives of self-supporting independence. Why have they done this? Undoubtedly it is to more than one cause that we must look for this result; but, at the outset of the discussion, it was universally admitted that Mr. Allen is right in considering the "higher education," to which he objects, to be the most potent factor in the situation. Furthermore, the knowledge of life in all its phases, which these women have gained, both from their intellectual training and their practical experience as bread-winners for themselves and others, makes them ready to accept most of his other premises.

They admit, that is, the physical necessity for maternity, and no man can appreciate its sacredness as they do.

They admit, again, the necessity for that tremendous overloading of the sexual instinct, whose meaning Emerson interprets when he says: "The lover seeks in marriage his private felicitation and perfection, with no prospective end; and Nature hides in his happiness her own end, namely, progeny, or the perpetuity of the race."

They admit, too, the value of the institution of marriage, and, as in the case of the ideal motherhood, put its beauty and its possibilities of happiness far beyond the usual masculine conception.

As to the continuance of the race, they are far too keen to blink any facts, even when they count against themselves. The race, at all costs, must go on, and women must be wives and mothers, or, to keep exactly to the lines laid down by Mr. Allen, *must* at least be mothers, to the end of time. And, following their logic to the bitter end, they admit that, under existing conditions, and probably for long periods yet to come, the women who assume motherhood as their vocation must be prepared to renounce, more or less completely, their chance for intellectual development.

To this point our argument, on the evening of which I speak, went smoothly enough. Little or no exception was taken to Mr. Allen's position. So long as he made himself only an exponent of natural laws, and of their inevitable effect upon the social fabric, there were no dissentient voices. But there came a moment when the question must be put point blank, and it was then that, for the first time, we, so to speak, came down to business.

"Now," I said, from my vantage-ground of neutrality, "you have cleared the decks. No social philosopher can demand more hearty agreement with the principles of his science than you have given; no man could desire more generous acknowledgment of man's place in creation, or of the fundamental relations of the sexes, than you offer; but the main issue is still untouched. Tell me why you, as representative individuals, have not married, do not marry, and are endeavoring, so far as educational methods can do it, to perpetuate your type?"

Masculine critics will possibly here suggest that a truthful answer to the first of these questions was far and away beyond my reach; but the women to whom I was speaking were fully in earnest, and there were no evasions.

"In the first place," said a clever woman beside me, "while we deny that our education unsexes us, we are conscious that it gives us a self-control, a balance, which is of inestimable advantage to us in the practical affairs of life, and induces us to consider marriage from more than one point of view. In the past, it is the emotional nature of women which has been cultivated, often at a heavy cost. Now, her intellect is taking charge, and we believe that there is no longer any reason why, as a rule, we should be sacrificed to our own emotions. Is it not, on the whole, desirable that women should study facts and weigh reasons as men do? You may say that it is the emotional virtues which are distinctively feminine, and that, as Mr. Allen says, 'a woman's glory is to be womanly, as a man's is to be *virile*'; but can it be shown that the training of her intellect makes a woman any less capable of love and devotion? Does it make her any less willing to sacrifice herself for the good of others? I think, on the contrary, that there is abundant witness to the fact that the increase of a woman's intellectual power usually intensifies her susceptibility to high motives, from whatever source they may reach her, or through whatever channel they may come. But, certainly, she is no longer a passive recipient;

she thinks now as well as feels, and the inevitable result is that her attitude is more judicial than of old."

"Do you know," here interpolates a newly graduated collegian, "that in our colleges it has become a proverb that, if a girl isn't engaged before she is a sophomore, the chances are all against her marriage?"

The assent to this is very general, and one of the older women states the evident reasons for it: "We become more interested in our studies, more certain of our ability to take care of ourselves, and therefore less interested in men as possible lovers, and more independent of them as a means of support."

"And also," dryly remarks a very marriageable maiden, "it becomes evident to us that, as a matter of fact, the men whom our friends marry do not always come to time in their *rôle* of 'providers,' and are not infrequently ready to accept assistance at the hands of the women whom they have undertaken to support."

Apropos of this, it is here suggested that possibly the prospect of domestic drudgery is not congenial to women who have found themselves capable of different and better work; and this is assented to by several of those present who are supporting their own establishments, and paying servants to perform the household labor which would fall upon their shoulders were they in the position of the married woman of average means.

This, again, suggests a comparison as to the relative value of the normal home wherein father, mother, and children complete the group, and of those more artificial homes which lack the natural elements of union. Generous recognition is at once given of the beauty of the possible home, and of the power and importance of the woman who creates it; but that this is woman's only field is emphatically denied. There are now open to her many channels through which she can influence the race, and the question is raised as to whether the advantage in this respect is altogether on the side of the married woman. Two or three of the older women in the group, who have had long and varied experience as teachers, ask if it is not probable that among the many children who have come into their hands there are not some, at least, who owe more to their school environment than to the home life. They claim that they, as teachers, should be credited with the influence which, in the nature of things, is inseparable from the responsibility which is put upon them. "To us," they say, "and not to the already overburdened wife and mother, is given the power to lead and direct the youth of the race. Would you have us, with that in view, aim for anything less than the best? The education of English and American children is, in the main, in the hands of women, and this not because of an anomalous social condition, but because of their peculiar fitness for the work. On Mr. Allen's own showing, these women should remain unmarried, and, if this involves a sacrifice on their part, it is left for him to show us that such sacrifice is ignoble, or in any sense threatening to the public welfare."

A response to this comes from the women physicians, who, in their work for their own sex and for children, feel, in all humility, that they are doing more for humanity than if they limited themselves to the reproduction of their kind. Granting that each of these women might leave behind her the ideal four successors, what is this in comparison with the many women whom she may have saved from disease and death; the households to which she has taught better ways; the new standards of purity and self-restraint for which she has bravely fought?

In such a discussion it is difficult not to individualize; but, well as I know these women, I am surprised at the breadth of their views, their candor, and their humility in regard to their own achievements. But it is a humility which permits no abatement of their just claims. They no longer admit any question as to their intellectual capacity. With the simplicity of conscious strength they take their place beside the men who challenge them, and are not at all afraid to face the result of their own actions. It is also plain that they are, on the whole, contented with the lot which they have chosen. The sacrifice, if it be such, has been made with open eyes and of free will, and there is no sighing after the possibilities which they have rejected.

"But," I ask, "do you never feel, especially as you grow older, the lack of some young strength upon which to lean, some fresh energy to which to bequeath your own experience?"

As might be expected, the answer to this is varied. In some instances the strength of the maternal instinct has led to the adoption of children; in others, to some special work which keeps up the connection with childhood; while again there are women, as there are men, in whom the instinct is lacking, and who find other interests sufficient to fill the gap.

Mr. Allen's suggestion as to the possible readjustment of the marriage relation, and his pledge that men will meet women halfway in any such attempt, is received without special enthusiasm. That is, the general feeling is, that it is not in the marriage relation, either in its legal or social aspect, that the root of the difficulty is to be found. Rather, they consider, it must be looked for in the standards with which men and women enter into that relation. It is constantly proved, by the evidence of happy marriages, that the contract easily adjusts itself where the parties to it comprehend and accept its terms. Not that there is not room for improvement in minor particulars, especially in the direction of certain legislative changes; but that, fundamentally, the monogamous idea, the permanent union of one woman with one man, is a trustworthy basis upon which to rest the social structure.

The women of whom I am writing disclaim positively that their indifference as to marriage arises from any dissatisfaction with the institution as it now and here exists. They deny also unanimously, and backed by a good deal of proof, that their education (it being understood that they have received the modern college education, or its equivalent) in any way unfits them for the duties of wifehood and maternity, or, primarily, renders these conditions any less attractive to them than to the "domestic" type of women. On the contrary, they hold that their knowledge of physiology makes them better mothers and housekeepers; their knowledge of chemistry makes them better cooks; while, from their training in other natural sciences and in mathematics, they obtain an accuracy and fair-mindedness which is of great value to them in dealing with their children or their employés. In short, they are not afraid to match themselves in practical life with the women for whom Mr. Allen claims a development impossible to the "dulled and spiritless epicene automata" to whom his attack is addressed.

As we approach the close of the discussion, the common sense of the various speakers makes itself strongly felt. They are not theorists, but practical, healthy women, and they do not in the least deceive themselves as to the actual, every-day aspect of this question. But, on the other hand, they stand for the feminine type of which our American prophet and seer wrote thirty years ago:[*] "At this moment I esteem it a chief felicity of this country that it excels in women. A certain awkward consciousness of inferiority in the men may give rise to the new chivalry in behalf of 'woman's rights.' Certainly, let her be as much better placed in the laws and in social forms as the most zealous reformer can ask; but I confide so entirely in her inspiring and musical nature that I believe only herself can show us how she shall be served. The wonderful generosity of her sentiments raises her at times into heroical and godlike regions, and verifies the pictures of Minerva, Juno, or Polymnia; and, by the firmness with which she treads her upward path, she convinces the coarsest calculators that another road exists than that which their feet know." And it is therefore no surprise to find that these women of a later generation are, finally, by the loftiness of their ideas and, as it were, in spite of themselves, lifted above the plane of Mr. Allen's arguments.

They sum up the reasons why they, as individuals, do not marry, in a somewhat formidable array. "We find," they say, "that we are intellectually the equals of the men whom we meet,

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[*] Emerson, "Essay on Manners."

It is now a fair give and take, and it is no longer required of us that we make up for the light weight of our intellects by throwing in a double measure of sentiment. Neither is it any longer necessary that we marry for the sake of a somewhat uncertain support. We are able to take care of ourselves, and we find nothing uncongenial or unsexing in our success.

"Furthermore, and above all, we see that, while the processes of evolution have pushed us so far forward that there is no longer, in our dealings with men, any serious question as to inferior or superior abilities, there still remains between our moral standards and theirs the same gap that has existed ever since the purity of woman has been tacitly recognized as essential to civilization.

"The moral sense is, in us, more highly developed than in the men who are otherwise our peers; and now that this is no longer deflected in its action by the pressure of unfair conditions, it is equivalent to a new factor in the relation of the sexes. It is evident, however, that this factor can not have full play except as the individual is independent; and it is to the single, self-supporting woman only that this independence is possible. Women who are dependent, in any direction, upon men, must, almost of necessity, condone their vices, and as a result gradually approximate to their standards, which is a consummation most devoutly *not* to be desired. We believe that there is no personal conceit in claiming that we are morally upon a higher level than men, this being a recognized fact in modern sociology; but it is a fact which repels us from the close relations of marriage, in which we now believe that we have a right to a return for all that we give. When, therefore, we find that, while we are offered intellectual companionship and provision for our physical needs, the higher demands of our spiritual nature are ignored or set aside, we naturally hesitate, and hesitating are, from Mr. Allen's point of view, lost. He looks at our problem from without, we from within. We realize, often in bitterness of heart, that our moral life, the life of our aspirations, is upon a plane which, as yet, the average man has not reached. We can never go back to him, but we stand ready to welcome him whenever he can bridge the chasm and make our standard his.

"This is our position as individuals; as a class we see no evidence that we are 'accidents,' still less that we are to be deplored. We believe indeed that, so far from this being true, we in reality represent an important phase in human development, that we are a distinct product of evolutionary forces, and that in the future it is not impossible that the 'balance of power' may be found to lie in our hands."

The value of this statement is in the fact that it comes not from one woman but from many, and in it there is surely nothing to discourage Mr. Allen and those who think with him. The women to whom he appeals are ready to meet him, but it must be on a platform of their own choosing, and they can afford to wait. They do not ask "aid in rebelling against maternity," but they demand that the responsibilities of fatherhood shall no longer be shifted or made light of. In short, they require of the fathers of the next generation just what Mr. Allen demands for the mothers, viz., "that they shall be as strong, as wise, as pure, as sane, as healthy, as earnest, and as efficient as they can be made."

And as this demand, on the part at least of the men who make it, is presumably based not so much on any personal predilection for the qualities enumerated as upon their desire to further the best interests of the race, the argument in its favor is as valid for the one sex as for the other.

ABSOLUTE POLITICAL ETHICS.

By HERBERT SPENCER.

LIFE in Fiji at the time when Thomas Williams settled there must have been something worse than uncomfortable. One of the people who passed near the string of nine hundred stones with which Ra Undreundre recorded the number of human victims he had devoured, must have had unpleasant waking thoughts and occasionally horrible dreams. A man who had lost some fingers for breaches of ceremony, or had seen his neighbor killed by a chief for behavior not sufficiently respectful, and who remembered how King Tanoa cut off his cousin's arm, cooked it and ate it in his presence, and then had him cut to pieces, must not unfrequently have had "a bad quarter of an hour." Nor could creeping sensations have failed to run through any women who heard Tui Thakan eulogizing his dead son for cruelty, and saying that "he could kill his own wives if they offended him, and eat them afterward." Happiness could not have been general in a society where there was a liability to be one among the ten whose life-blood baptized the decks of a new canoe—a society in which the killing even of unoffending persons was no crime but a glory; and in which every one knew that his neighbor's restless ambition was to be an acknowledged murderer. Still there must have been some moderation in murdering even in Fiji. Or must we hesitate to conclude that unlimited murder would have caused extinction of the society?

The extent to which each man's possessions among the Biluchis are endangered by the predatory instincts of his neighbors, may be judged from the fact that "a small mud tower is erected in each field, where the possessor and his retainers guard his produce." If turbulent states of society such as early histories tell of, do not show us so vividly how the habit of appropriating one another's goods interferes with social prosperity and individual comfort, yet they do not leave us in doubt respecting these results. It is an inference which few will be hardy enough to dispute, that in proportion as the time of each man, instead of being occupied in further production, is occupied in guarding that which he has produced against marauders, the total production must be diminished and the sustentation of each and all less satisfactorily achieved. And it is a manifest corollary that if each pushes beyond a certain limit the practice of trying to satisfy his needs by robbing his neighbor, the society must dissolve: solitary life will prove preferable.

A deceased friend of mine, narrating incidents in his life, told me that as a young man he sought to establish himself in Spain as a commission agent; and that, failing by expostulation or other means to obtain payment from one who had ordered goods through him, he, as a last resource, went to the man's house and presented himself before him pistol in hand—a proceeding which had the desired effect: the account was settled. Suppose now that everywhere contracts had thus to be enforced by more or less strenuous measures. Suppose that a coal-mine proprietor in Derbyshire, having sent a train-load to a London coal-merchant, had commonly to send a *posse* of colliers up to town, to stop the man's wagons and take out the horses until payment had been made. Suppose the farm laborer or the artisan was constantly in doubt whether, at the end of the week, the wages agreed upon would be forthcoming, or whether he would get only half, or whether he would have to wait six months. Suppose that daily in every shop there occurred scuffles between shopman and customer, the one to get the money without giving the goods, and the other to get the goods without paying the money. What in such case would happen to the society? What would become of its producing and distributing businesses? Is it a rash inference that industrial co-operation (of the voluntary kind at least) would cease?

"Why these absurd questions?" asks the impatient reader. "Surely every one knows that murder, assault, robbery, fraud, breach of contract, etc., are at variance with social welfare and must be punished when committed." My replies are several. In the first place, I am quite content to have the questions called absurd; because this implies a consciousness that the answers are so self-evident that it is absurd to assume the possibility of any other answers. My second reply is that I am not desirous of pressing the question *whether* we know these things, but of pressing the question *how* we know these things. Can we know them, and do we know them, by contemplating the necessities of the case? or must we have recourse to "inductions based on careful observation and experience"? Before we make and enforce laws against murder, ought we to inquire into the social welfare and individual happiness in places where murder prevails, and observe whether or not the welfare and happiness are greater in places where murder is rare? Shall robbery be allowed to go on until, by collecting and tabulating the effects in countries where thieves predominate and in countries where thieves are but few, we are shown by induction that prosperity is greater when each man is allowed to retain that which he has earned? And is it needful to prove by accumulated evidence that breaches of contract impede production and exchange, and those benefits to each and all which mutual dependence achieves? In the third place, these instances of actions which, pushed to extremes, cause social dissolution, and which, in smaller degrees, hinder social co-operation and its benefits, I give for the purpose of asking what is their common trait. In each of such actions we see aggression—a carrying on of life in a way which directly interferes with the carrying on of another's life. The relation between effort and consequent benefit in one man, is either destroyed altogether or partially broken by the doings of another man. If it be admitted that life can be maintained only by certain activities (the internal ones being universal, and the external ones being universal for all but parasites and the immature), it must be admitted that when like-natured beings are associated, the required activities must be mutually limited; and that the highest life can result only when the associated beings are so constituted as severally to keep within the implied limits. The restrictions stated thus generally, may obviously be developed into special restrictions referring to this or that kind of conduct. These, then, I hold are *a priori* truths which admit of being known by contemplation of the conditions—axiomatic truths which bear to ethics a relation analogous to that which the mathematical axioms bear to the exact sciences.

I do not mean that these axiomatic truths are cognizable by all. For the apprehension of them, as for the apprehension of simpler axioms, a certain mental growth and a certain mental discipline are needed. In the "Treatise on Natural Philosophy" by Profs. Thomson and Tait, it is remarked that "physical axioms are axiomatic to those only who have sufficient knowledge of the action of physical causes to enable them to see at once their necessary truth." Doubtless a fact and a significant fact. A plow-boy can not form a conception of the axiom that action and reaction are equal and opposite. In the first place he lacks a sufficiently generalized idea of action—has not united into one conception pushing and pulling, the blow of a fist, the recoil of a gun, and the attraction of a planet. Still less has he any generalized idea of reaction. And even had he these two ideas, it is probable that, defective in power of representation as he is, he would fail to recognize the necessary equality. Similarly with these *a priori* ethical truths. If a speculative member of that Fijian slave-tribe who regarded themselves as food for the chiefs had suggested that there might come a place where men would not eat one another, his implied belief that they might come to have a little respect for one another's lives, condemned as utterly without justification in experience, would be considered as fit only for a wild speculator. Facts furnished by every-day observation make it clear to the Biluchi, keeping watch in his mud tower, that possession of property can be maintained only by force; and it is most likely to him scarcely conceivable that there exist limits which, if mutually recognized, may exclude aggressions, and make it needless to mount guard over fields: only an absurd idealist (supposing such a thing known to him) would suggest the possibility. And so even of our own ancestors in feudal times, it may be concluded that, constantly going about armed and often taking refuge in strongholds, the thought of a peaceful social state would have seemed ridiculous; and the belief that there might be a recognized equality among men's claims to pursue the objects of life, and a consequent desistence from aggressions, would have been scarcely conceivable. But now that an orderly social state has been maintained for generations—now that in daily intercourse men rarely use violence, commonly pay what they owe, and in most cases respect the claims of the weak as well as those of the strong—now that they are brought up with the idea that all men are equal before the law, and daily see judicial decisions turning upon the question whether one citizen has or has not infringed upon the equal rights of another; there exist in the general mind materials for forming the conception of a *régime* in which men's activities are mutually limited, and in which maintenance of harmony depends on respect for the limits. There has arisen an ability to see that mutual limitations are necessitated when lives are carried on in proximity; and to see that there necessarily emerge definite sets of restraints applying to definite classes of actions. And it has become manifest to some, though not it seems to many, that there results an *a priori* system of absolute political ethics—a system under which men of like natures, severally so constituted as spontaneously to refrain from trespassing, may work together without friction, and with the greatest advantage to each and all.

"But men are not wholly like-natured and are unlikely to become so. Nor are they so constituted that each is solicitous for his neighbor's claims as for his own, and there is small probability that they ever will be. Your absolute political ethics is therefore an ideal beyond the reach of the real." This is quite true. Nevertheless, much as it seems to do so, it does not in the least follow that there is no use for absolute political ethics. The contrary may clearly enough be shown. An analogy will explain the paradox.

There exists a division of physical science distinguished as abstract mechanics or absolute mechanics—absolute in the sense that its propositions are unqualified. It is concerned with statics and dynamics in their pure forms—deals with forces and motions considered as free from all interferences resulting from friction, resistances of media, and special properties of matter. If it enunciates a law of motion, it recognizes nothing which modifies manifestation of it. If it formulates the properties of the lever it treats of this assuming it to be perfectly rigid and without thickness—an impossible lever. Its theory of the screw imagines the screw to be frictionless; and in treating of the wedge, absolute incompressibility is supposed. Thus its truths are never presented in experience. Even those movements of the heavenly bodies which are deducible from its propositions are always more or less perturbed; and on the Earth the inferences to be drawn from them deviate very considerably from the results reached by experiment. Nevertheless this system of ideal mechanics is indispensable for the guidance of real mechanics. The engineer has to deal with its propositions as true in full, before he proceeds to qualify them by taking into account the natures of the materials he uses. The course which a projectile would take if subject only to the propulsive force and the attraction of the Earth must be recognized, though no such course is ever pursued: correction for atmospheric resistance can not else be made. That is to say, though, by empirical methods, applied or relative mechanics may be developed to a considerable extent, it can not be highly developed without the aid of absolute mechanics. So is it here. Relative political ethics, or that which deals with right and wrong in public affairs as partially determined by changing circumstances, can not progress without taking into account right and wrong considered apart from changing circumstances—can not do without absolute political ethics; the propositions of which, deduced from the conditions under which life is carried on in an associated state, take no account of the special circumstances of any particular associated state.

And now observe a truth which seems entirely overlooked: namely, that the set of deductions thus arrived at is verified by an immeasurably vast induction, or rather by a great assemblage of vast inductions. For what else are the laws and judicial systems of all civilized nations, and of all societies which have risen above savagery? What is the meaning of the fact that all peoples have discovered the need for punishing murder, usually by death? How is it that where any considerable progress has been made, theft is forbidden by law, and a penalty attached to it? Why along with further advance does the enforcing of contracts become general? And what is the reason that among fully civilized peoples frauds, libels, and minor aggressions of various kinds are repressed in more or less rigorous ways? No cause can be assigned save a general uniformity in men's experiences, showing them that aggressions directly injurious to the individuals aggressed upon are indirectly injurious to society. Generation after generation observations have forced this truth on them; and generation after generation they have been developing the interdicts into greater detail. That is to say, the above fundamental principle and its corollaries arrived at *a priori* are verified in an infinity of cases *a posteriori*. Everywhere the tendency has been to carry further in practice the dictates of theory—to conform systems of law to the requirements of absolute political ethics: if not consciously, still unconsciously. Nay, indeed, is not this truth manifest in the very name used for the end aimed at—equity or equalness? Equalness of what? No answer can be given without a recognition—vague it may be, but still a recognition—of the doctrine above set forth.

Thus, instead of being described as putting faith in "long chains of deduction from abstract ethical assumptions" I ought to be described as putting faith in simple deductions from abstract ethical necessities; which deductions are verified by infinitely numerous observations and experiences of semi-civilized and civilized mankind in all ages and places. Or rather I ought to be described as one who, contemplating the restraints everywhere put upon the various kinds of transgressions, and seeing in them all a common principle everywhere dictated by the necessities of the associated state, proceeds to develop the consequences of this common principle by deduction, and to justify both the deductions and the conclusions which legislators have empirically reached by showing that the two correspond. This method of deduction verified by induction is the method of developed science at large. I do not believe that I shall be led to abandon it and change my "way of thinking" by any amount of disapproval, however strongly expressed.

Are we then to understand that by this imposing title, "Absolute Political Ethics," nothing more is meant than a theory of the needful restraints which law imposes on the actions of citizens—an ethical warrant for systems of law? Well, supposing even that I had to answer "Yes" to this question (which I do not), there would still be an ample justification for the title. Having for its subject-matter all that is comprehended under the word

"Justice," alike as formulated in law and administered by legal instrumentalities, the title has a sufficiently large area to cover. This would scarcely need saying were it not for a curious defect of thought which we are everywhere led into by habit.

Just as, when talking of knowledge, we ignore entirely that familiar knowledge of surrounding things, animate and inanimate, acquired in childhood, in the absence of which death would quickly result, and think only of that far less essential knowledge gained at school and college or from books and conversation —just as, when thinking of mathematics, we include under the name only its higher groups of truths and drop out that simpler group constituting arithmetic, though for the carrying on of life this is more important than all the rest put together; so, when politics and political ethics are discussed, there is no thought of those parts of them which include whatever is fundamental and long settled. The word political raises ideas of party-contests, ministerial changes, prospective elections, or else of the Home-Rule question, the Land-Purchase scheme, Local Option, or the Eight-Hours movement. Rarely does the word suggest law-reform, or a better judicial organization, or a purified police. And if ethics comes into consideration, it is in connection with the morals of parliamentary strife or of candidates' professions, or of electoral corruptions. Yet it needs but to look at the definition of politics ("that part of ethics which consists in the regulation and government of a nation or state, for the preservation of its safety, peace, and prosperity"), to see that the current conception fails by omitting the chief part. It needs but to consider how relatively immense a factor in the life of each man is constituted by safety of person, security of house and property, and enforcement of claims, to see that not only the largest part but the part which is vital is left out. Hence the absurdity does not exist in the conception of an absolute political ethics, but it exists in the ignoring of its subject-matter. Unless it be considered absurd to regard as absolute the interdicts against murder, burglary, fraud, and all other aggressions, it can not be considered absurd to regard as absolute the ethical system which embodies these interdicts.

It remains to add that beyond the deductions which, as we have seen, are verified by vast assemblages of inductions, there may be drawn other deductions not thus verified—deductions drawn from the same data, but which have no relevant experiences to say yes or no to them. Such deductions may be valid or invalid; and I believe that in my first work, written forty years ago and long since withdrawn from circulation, there are some invalid deductions. But to reject a principle and a method because of some invalid deductions is about as proper as it would be to pooh-pooh arithmetic because of blunders in certain arithmetical calculations.

I turn now to a question above put—whether, by absolute political ethics, nothing more is meant than an ethical warrant for systems of law—a question to which, by implication, I answered No. And now I have to answer that it extends over a further field equally wide if less important. For beyond the relations among citizens taken individually, there are the relations between the incorporated body of citizens and each citizen. And on these relations between the State and the man, absolute political ethics gives judgments as well as on the relations between man and man. Its judgments on the relations between man and man are corollaries from its primary truth, that the activities of each in pursuing the objects of life may be rightly restricted only by the like activities of others: such others being like-natured (for the principle does not contemplate slave-societies or societies in which one race dominates over another); and its judgments on the relations between the man and the State are corollaries from the allied truth, that the activities of each citizen may be rightly limited by the incorporated body of citizens only as far as is needful for securing to him the remainder. This further limitation is a necessary accompaniment of the militant state; and must continue so long as, besides the criminalities of individual aggression, there continue the criminalities of international aggression. It is clear that the preservation of the society is an end which must take precedence of the preservation of its individuals taken singly; since the preservation of each individual and maintenance of his ability to pursue the objects of life, depend on the preservation of the society. Such restrictions upon his actions as are imposed by the necessities of war, and of preparedness for war when it is probable, are therefore ethically defensible.

And here we enter upon the many and involved questions with which relative political ethics has to deal. When originally indicating the contrast, I spoke of "absolute political ethics, or that which ought to be, as distinguished from relative political ethics, or that which is at present the nearest practicable approach to it"; and had any attention been paid to this distinction, no controversy need have arisen. Here I have to add that the qualifications which relative political ethics sets forth vary with the type of the society, which is primarily determined by the extent to which defense against other societies is needful. Where international enmity is great and the social organization has to be adapted to warlike activities, the coercion of individuals by the State is such as almost to destroy their freedom of action and make them slaves of the State; and where this results from the necessities of defensive war (not offensive war, however), relative political ethics furnishes a warrant. Conversely, as militancy decreases, there is a diminished need both for that subordination of the individuals which is necessitated by consolidating them into a fighting machine, and for that further subordination entailed by supplying this fighting machine with the necessaries of life; and as fast as this change goes on, the warrant for State-coercion which relative political ethics furnishes becomes less and less.

Obviously it is out of the question here to enter upon the complex questions raised. It must suffice to indicate them as above. Should I be able to complete Part IV of the "Principles of Ethics" treating of "Justice," of which the first chapters only are at present written, I hope to deal adequately with these relations between the ethics of the progressive condition and the ethics of that condition which is the goal of progress—a goal ever to be recognized, though it can not be actually reached.

The grave misrepresentations dealt with in the foregoing sections, I have been able to rectify by an exposition that is mainly impersonal: allusions, only, having been made to the personal bearings of the argument. But there remain other grave misrepresentations which I can not dispose of in the same way. Life sometimes presents alternatives both of which are disagreeable, and acceptance of either of which is damaging. A choice between two such I now find myself compelled to make. Prof. Huxley, referring to me, speaks of "the gulf fixed between his way of thinking and mine": the implication being that as he regards his own "way of thinking" as the right one, my way of thinking, separated from it by a gulf, must be extremely wrong. As this tacit condemnation of my "way of thinking" touches not only the question at issue but also many other questions, and as it comes not from an anonymous critic, but from one whose statements will be taken as trustworthy, I am placed in the dilemma of either passively allowing his injurious characterization, or else of showing that it is untrue, which I can not do without describing or illustrating my "way of thinking." This is, of course, an unpleasant undertaking, and one which self-respect would ordinarily negative. But unpleasant as it is, I feel obliged to enter upon it.

Years ago Prof. Huxley criticised the political doctrine held by me, and entitled his article "Administrative Nihilism." As this doctrine includes advocacy of governmental action for the repression not only of crimes but of many minor offenses, I pointed out that if it is to be called "administrative nihilism," then still more must the eight prohibitory clauses of the decalogue be called ethical nihilism. Prof. Huxley nevertheless thought his title a fit one; and has continued to use it in the last edition of his "Critiques and Addresses." This political doctrine held by me remains unchanged, but the view taken of it by Prof. Huxley appears to have been reversed. In an emphatic manner he has recently warned me against "undertaking to preserve the health and heal the diseases of an organism vastly more complicated than the human body," having for my guides "long chains of deduction from abstract ethical assumptions." So that while represented as one who would have no administration at all, I am represented as advocating dangerous administrative methods of healing diseases of the body politic. My policy is characterized now as a policy of no action, and now as a policy of rash action. These two characterizations are applied to the same set of beliefs, and they stand in direct contradiction. Necessarily there must be extreme error in one or both; and the latter alternative is the true one: both are wrong.

The "way of thinking" which Prof. Huxley indicates as separated by a gulf from his own, and which he implies is exclusively pursued by me, is that of reaching conclusions by "long chains of deduction from abstract ethical assumptions, hardly any link of which can be tested experimentally." On the other hand the course he advocates is that of seeking guidance from "inductions based on careful observation and experience"—a course which he implies is not pursued by me, either in the political sphere or elsewhere; certainly not in the political sphere. Now let us ask what is implied by the evidence. Up to the end of the division treating of Ecclesiastical Institutions, where it has stood still for these four years, the "Principles of Sociology" contains more than five thousand facts, gathered from accounts of more than two hundred societies, savage and civilized, ancient and modern. If, then, I am rightly described as pursuing the deductive method (exclusively, as it would appear), there arises this curious question:—How have I used for deductive purposes more facts than have been used by any other writer on Sociology for inductive purposes? "This is irrelevant," will perhaps be the rejoinder—"the question concerns not the method pursued in dealing with Sociology at large, but the method pursued in dealing with governmental actions at the present time." Merely remarking that it would be strange had I pursued one method in treating the subject at large and an opposite method in treating a small division of it, I go on to reply that I have *not* pursued the opposite method but the same method. The views I hold respecting the sphere of governmental action are everywhere supported by inductions. The essay on "Over-Legislation," dating back to 1853, is almost wholly inductive. Inductive reasoning in support of the same views occupies the greater part of the essay on "Representative Government," much of the essay on "Parliamentary Reform: the Dangers and the Safeguards," and half of the essay on "Specialized Administration." In the "Study of Sociology," again, several masses of facts are brought in support of the same views (pp. 3, 4, 161–169, and 270–273); and once more in "The Man *versus* the State" (pp. 48–60 and 62–64) a like course is pursued. I count, in different places, eight inductive arguments, not in defense of proposals for curing the diseases of the body politic, but in reprobation of proposals for doing this. "But do not the books and essays named contain deductive arguments?" it may be asked. Certainly they do; and I should be ashamed of them if they did not. But everywhere there has been pursued what I have above said is the method of developed science—deduction verified by induction. I shall think it time to reconsider the deductions when I find the masses of facts which support them met by larger masses of facts which do the reverse. "Careful observation and experience" have not yet furnished these.

To make clear the use of an ideal for guidance in dealing with the real, I had recourse to the familiar comparison between the individual body and the body politic. I remarked that "before there can be rational treatment of a disordered state of the bodily functions, there must be a conception of what constitutes their ordered state." The guidance contemplated as derivable from such knowledge consists in exclusion of what is wrong to be done, not in directions concerning what is right to be done. This is clearly shown by the context. There is an imaginary warning against the excesses of a supposed empiric as being "at variance with physiological principles"; that is, *negatived* by them or *forbidden* by them. There is no trace whatever of any proposed treatment conforming to physiological principles, but merely an interdict against a treatment. Yet on the strength of these passages, Prof. Huxley ascribes to me the monstrous belief that the practitioner should "treat his patients by deduction from physiological principles"! Similarly with the body politic. While I have alleged that "a system of *limits and restraints* on conduct" may be deduced from the primary conditions of social co-operation, Prof. Huxley represents me as proposing to seek guidance in *healing* "the diseases of an organism vastly more complicated than the human body" by "deduction from abstract ethical assumptions!" While in both cases the guiding inferences indicated by me all come under the blank form—"Thou shalt not do this," they are represented as coming under the blank form—"Thou shalt do that." How utterly at variance is the view thus ascribed to me with the view I have myself expressed, will be seen in the following passage:

How, indeed, can any man, and how more especially can any man of scientific culture, think that special results of special political acts can be calculated, when he contemplates the incalculable complexity of the influences under which each individual, and *a fortiori* each society, develops, lives, and decays? . . .

As fast as crude conceptions of diseases and remedial measures grow up into Pathology and Therapeutics, we find increasing caution, along with increasing proof that evil is often done instead of good. This contrast is traceable not only as we pass from popular ignorance to professional knowledge, but as we pass from the smaller professional knowledge of early times to the greater professional knowledge of our own. The question with the modern physician is not as with the ancient—shall the treatment be blood-letting? shall cathartics, or shall diaphoretics be given? or shall mercurials be administered? But there rises the previous question—shall there be any treatment beyond a wholesome regimen? And even among existing physicians it happens that, in proportion as the judgment is most cultivated, there is the least yielding to the "must-do-something" impulse.

Is it not possible, then—is it not even probable, that this supposed necessity for immediate action, which is put in as an excuse for drawing quick conclusions from few data, is the concomitant of deficient knowledge? Is it not probable that as in Biology so in Sociology, the accumulation of more facts, the more critical comparison of them, and the drawing of conclusions on scientific methods, will be accompanied by increasing doubt about the benefits to be secured, and increasing fear of the mischiefs which may be worked? Is it not probable that what in the individual organism is improperly, though conveniently, called the *vis medicatrix naturæ*, may be found to have its analogue in the social organism? and will there not very likely come along with the recognition of this, the consciousness that in both cases the one thing needful is to maintain the conditions under which the natural actions have fair play?—*The Study of Sociology*, pp. 15–21.

Manifestly if, instead of saying that I proposed to treat the diseases of this complex social organism by the aid of deductions from "abstract ethical assumptions," Prof. Huxley had, contrariwise, said that I am so over-cautious that I dare not treat them at all, save by maintaining the conditions to health, he would have had ground for his statement. As early as 1853 ("Over-Legislation," pp. 62, 63) I dwelt on the involved structure of a society and the consequent difficulty and danger of dealing with it. Since then I have more than once insisted on these facts. And now that which I have been teaching for a generation is put before me as a lesson to be learned!

Replies will, I suppose, be made to some of the things said in the foregoing pages. Always there are collateral questions on which debates may be raised. I see, for instance, that one of my remarks may have given to it a meaning quite different to that which I intended. After the ascription to me of the belief that treatment of diseases should be dictated by physiological principles, rightly enough regarded by Prof. Huxley as absurd, there came from me the remark that, according to him, "the principles of physiology, as at present known, are of no use whatever for guidance in practice"—a remark which may be interpreted as a tacit indorsement of the ascription; whereas it referred to the fact that he had recognized for the present (though not for the future) no guidance whatever beyond that of empiricism. Doubtless there may be other side-issues which I do not perceive. But no number of such can change the verdicts on the main issues. That Prof. Huxley's two characterizations of the political doctrine I hold are contradictory, is undeniable. That his description of my "way of thinking" is utterly at variance with the evidence as presented in my books, is no less demonstrated. And it is equally certain that the conceptions of right treatment, medical and political, which he ascribes to me are opposite to those I have myself set forth.—*Nineteenth Century.*

THE LAWS OF FILMS.

By SOPHIE BLEDSOE HERRICK.

THERE is scarcely anything in the world which seems more utterly outside the realm of law than a soap-bubble. The delicate film, with its exquisite floating colors, its power of instantly vanishing, leaving no trace behind, hardly seems as though it could form a link in the inexorable chain of cause and effect which we call physical law.

The atmospheric pressure on a bubble six inches in diameter is over fifteen hundred pounds, and yet the fragile film lies safely between the opposing forces of nature—the pressure of the outer air, the spring of the inclosed cushion within it, the downward pull of gravity, the upward push of the buoyant atmosphere, and the molecular forces in the film itself: so long as the bubble lasts; it is because of an exquisite adjustment of all the forces, physical and molecular, concerned in its existence.

This is, of course, the merest commonplace, and yet it is one of the commonplaces of nature, which, however well we may know them, never cease to be wonderful when they are in any degree realized. There are other laws governing films which are no less wonderful, though they are less familiarly known. A heap of bubbles blown while the pipe is dipped under the surface of soapy water looks like a chaotic huddle of bubbles of all sizes and many shapes; but, upon careful examination, it is found that never more than three films meet at an unsupported liquid edge, and never more than four edges meet at a liquid point, and that the angles are always equal; that is, films will not meet each other at an unsupported edge or point at an angle smaller than 120°—one third of a circle.

Ordinary soap-suds made with clean hot water and ivory or pure Castile soap, and allowed to settle and clarify, or else filtered, answer very well for a series of simple and beautiful experiments in the forms assumed by soap films in order to fulfill this law of their union. There is a glyceric fluid made, which by various means has all the impurities of soap and water removed, and is toughened by the addition of pure glycerin; and this is of course better, because much more persistent. A bubble made from this glyceric fluid, and carefully protected by a tumbler or bell-glass, will last for hours, and in some cases for days.

For these experiments in form, common suds last long enough to show the forms very satisfactorily, but for experiment in color the more lasting fluid is necessary, so a recipe for it is given here.*

When frames made in various forms, by bending fine copper wire, are dipped into the fluid, it is found that the films take on the most wonderful and beautiful shapes in order to fulfill the law of their union. The material of which the films are made does not at all affect their form.

With fine, well-straightened copper wire, outline a cube; this may be done with the fingers or a pair of ordinary pliers, and the figure need not be very exact. The wires can be double along any of the lines; let one end project from some corner for a handle, to be used in dipping the frame into the fluid.

Immerse this cube in the suds, and as you lift the frame out observe the films forming and shaping themselves. They usually take for a moment the form in Fig. 1 and slowly change to Fig. 2. Sometimes they retain the first form; in this case, the central drop with a glass of low power is seen to be not really a drop of fluid, but a tiny cube of films, each meeting the film from the wire edge by a curvature of its faces at exactly the required angle, 120°. The films have constructed in their midst this tiny cube, because the twelve films could not otherwise meet in the center at the proper angle. This cube is formed and kept where a tiny bubble has been entrapped in the system of films. If no such bubble of air has been caught in with the films, they assume the form of Fig. 2. The twelve films from the edges of the cube meet a square unsupported plate of film in the center.

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* Plateau's mixture. This must be made in a warm room, temperature about 68° Fahr. Let one half ounce of newly made Marseilles or pure Castile soap be dissolved in one pint (twenty ounces) of hot distilled water. When the solution has cooled to about the temperature of the room, it is filtered into a bottle. In using the common filter paper (bought at a drug-store for ten cents a dozen sheets), it is better to put only a small quantity of the mixture in at a time, and to support the paper in a funnel or muslin to prevent its breaking. The paper soon clogs; it should then be renewed. The process is slow, but not troublesome. When it has all been filtered, add fifteen ounces of pure glycerin—either [illegible] cheering and Glatz's—the ordinary glycerins are not fit for the purpose. Let the [illegible] ly and frequently shaken; then allow it to stand seven days; on the [illegible] 37° Fahr., and filter. If the liquid comes through turbid, pour it [illegible] through *very* porous paper.

With No. 2 still on the frame, dip it again into the suds. You catch a bubble by doing this which goes at once to the center (Fig. 3), and forms such a cube as existed at the center of Fig. 1, only large enough to show the curvature of the films necessary to make them meet at their fixed angle. The laws of films formulated are as follows: 1. From each wire edge of a frame proceeds a film. Generally, if care be taken, no air will be inclosed, then every film will be in contact with the surrounding air on both its faces. 2. Only three films can meet at any liquid edge. 3. When several liquid edges terminate in one point in the interior of the system, the edges are always four in number, and the angles included between them are equal. 4. Whenever the films can fulfill these conditions, and remain plain films, they are so; when they can not, they are curved, but so curved that their mean curvature is null—that is, if in one part of the film the law of its union requires an upward curvature, in some other portion there will be an equal downward curvature to compensate for it.

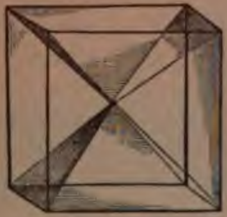

FIG. 1.

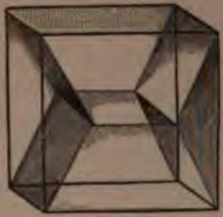

FIG. 2.

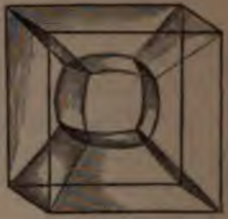

FIG. 3.

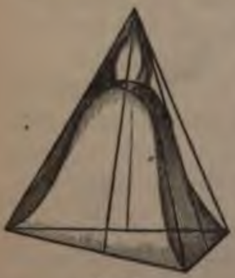

FIG. 4.

In the films upon the cube frame, for instance, there is a slight curvature, just enough to enable them to meet each other on the angle of 120°. This is a very simple digression from the plane form, but in many other frames the divergence is very marked; for instance, in the triangular pyramid (Fig. 4) with wires dividing each side, after a bubble has been entrapped by a second dip, the curvature is very remarkable.

Plateau, the blind philosopher of Ghent, first studied this subject and formulated these laws. He began his studies with some experiments far removed from our films. In order to get some idea of the interaction of the molecular forces, he removed a mass of liquid matter he was observing, as far as he could, from the action of the physical forces. Using the well-known principle that a submerged body sinks till it has displaced its own weight of the fluid in which it is immersed, he made a mixture of alcohol and water of exactly the specific gravity of oil. Into the midst of this liquid he quietly introduced oil by means of a funnel. The oil lay passive between the equal downward pull of gravity and the upward lift of the alcohol and water. In this way the forces which bound the oil particles together had free play. The oil rounded itself at once into a sphere. For a time there was, of course, some chemical action between the oil sphere and the surrounding liquid; but, in making his observations, Plateau waited till these affairs had been settled between them, and their relations became fixed.

He then introduced into his oil sphere a rod, with a disk smaller in circumference than the oil sphere about it. Both of these were well oiled, and they entered the sphere without disturbing it. The globe of oil hung in the water, with the rod running through it in the position of the earth's axis, and the disk almost reaching to the line corresponding with our equator (Fig. 5).

By means of a handle the rod was turned, at first slowly, then gradually and steadily faster. The oil sphere slipped more easily around in its water socket than it would around the revolving rod and disk, and therefore turned upon its own axis. By varying his experiments, revolving his rod faster or slower, Plateau made a miniature representation of a world revolving about its own axis; he made his oil sphere throw off satellites, which revolved about the central sphere; he also, by what he calls a trick, imitated Saturn with its attendant ring.

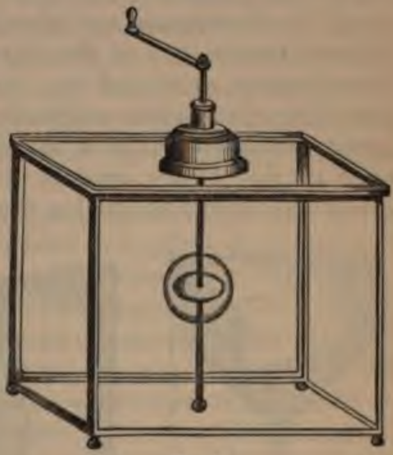
FIG. 5.

He followed these experiments by using outlined frames of wire, such as we used for our soap films. These he adjusted around his hanging sphere of oil, and with a syringe withdrew the oil, making first a cube of oil with unsupported faces; and finally, as more and more oil was withdrawn, there resulted a system of oil films, each face of which was in contact with the water, exactly like those in Figs. 1 and 2.

This was the manner in which such systems of films were first reached; and, historically, the experiments have an interest in their relation to the subject of films as well as for the proof they offer that the material of which the films are formed has nothing to do with the forms they take on. Plateau went on from his oil films to those made with soap-suds and glyceric fluid. We have reversed the order in considering them, but it amounts to the same thing in the end.

Plateau's researches have been carried on by Brewster and others, and the subject much enriched by later experimenters. One of the most beautiful forms has not, it is believed, been published. A sphere is outlined with three equal circles, making, when joined together at equal angles, a globe with six meridians. When this is dipped in the suds, a rather complicated figure appears. It is sometimes necessary to dip this frame several times to get a perfect figure. From an axial edge of film three films start out. Just half-way between the axis and the outside curve of the sphere each of these three films meet two crescent-shaped films from two of the wire meridians, curved so that the three meet at the required angle. Sometimes when a bubble has been caught in the system, and always if a small bubble is carefully blown between two of the wires, a new figure will be formed. In an instant, as though the change were wrought by magic, the new figure flashes into existence. A long, six-sided, melon-shaped figure reaches from pole to pole inside the sphere; from each edge of this figure, entirely unsupported as it is by the wire, a crescent-shaped film reaches to each wire meridian.

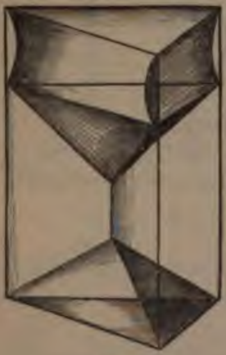

Fig. 6.

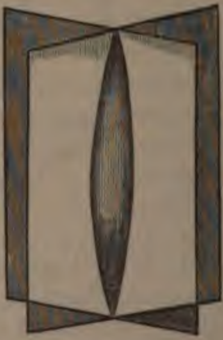

Fig. 7.

The figures formed with the wire frames are usually perfectly symmetrical; but sometimes, from the peculiar form of the frame, symmetry is not consistent with a union at the angle of 120°. The law in such a case is obeyed, and symmetry cast to the winds. In Fig. 6, at the first dip the figure is very unsymmetrical, though always the same. When a bubble is blown on the bottom, the figure starts out perfectly symmetrical in form.

Brewster has added many experiments to those of Plateau's. The next one given is his, and a very curious one it is too. Two rectangles are made of the copper wire; one is slipped within the other and held at right angles to it; they are in this position dipped into the suds. The system which starts into being can be seen in Fig. 7. The central oval stands diagonally just half-way between two of the angles made by the crossed frames. Now, if the frames are gradually turned upon each other, which it is very easy to do, the form of the oval changes. At right angles the oval film is four times longer than it is broad. As the angle between which the oval film stands is increased, it widens till it is nearly square. If the rectangles could be made to lie exactly one upon the other, the oval film would fill up the space. Now, when the angle of the two wire frames is made narrower instead of wider, the oval narrows till, at 45°, it is a line, and in one moment the system has changed: the oval stands between the wider angle just across its old position and at right angles to it.

A still more remarkable change takes place when a bubble is blown upon the oval film, the lines being at right angles to each other. When it reaches the proper size, all the films disappear, and a hollow curvilinear cube is formed, each side curving out from the wires which define its vertical edges. At the top and bottom the wires make a cross on the film; in each of these triangular spaces four summits appear; colored rings form around them; a black spot shows in the center of each summit, and the bubble bursts. If the wires are held straight up and down when the bubble bursts, the old system of films will start into being again, as if it had left its ghost behind it to recover the elements which the bubble had appropriated.

Dr. Sloane, in his "Home Experiments in Science," gives some beautiful figures. A wire is bent in a spiral, with one end turned straight up through the middle like an axis. Dipped in the fluid, it gives a single spiral film curving around the central wire as a spiral staircase curves around its central pillar. He also gives some very simple and interesting experiments showing the traction of films, requiring no special apparatus or fluid, and so within the reach of every one. All the frames used in this article were made of thin copper wire bent into shape with the fingers or a pair of pliers. Of course, if the wires are soldered instead of being twisted together, and are covered with a thin film of paraffin by rubbing a so-called wax candle on them and then holding the frame above but not too near a bed of coals, the films will last longer; but that is the only difference.

The wonderful traction of films is shown by the recent experiments with oil upon the waves in a storm. The oil, of course, does not still the waves, but it converts the combing waves, so dangerous to navigators, into a comparatively harmless swell. It is the traction of the film which prevents the wind from drawing the water up the incline of the wave and sending it jetting upward to fall over in a comb. A film of oil $\frac{1}{2000000}$ of an inch in thickness will hold the wave of water driving before a gale so that it can not break into spray.

The closing words in Brewster's experiment on the revolving rectangles of wire bring us to another remarkable though familiar fact in regard to films—their wonderful and changing colors, what in scientific language is called "the colors of thin plates," because the same effect is produced in many cases where "film" is not exactly the word to use.

The colors of soap-bubbles furnish one of the most triumphant vindications of the wave theory of light, and offer to its opposers one of the hardest possible nuts to crack. A brief explanation of the wave theory of light and interference, so far as it bears upon our subject, will, it is hoped, be pardoned. It is an idea so familiar to those who have studied physics, and yet so difficult of conception to those who have not, that a few words seem necessary in a popular exposition of the colors of films.

Light is, of course, our name for the sensation, but back of the sensation there lie the physical conditions which are its cause. The theory of Newton, that light is caused by minute particles of matter shot out from the luminous body, stood the test of the simpler phenomena; but, when it came to the explanation of soap-bubble colors, his theory, even with the marvelous ingenuity which he brought to bear upon it, broke down. If light were matter, it is impossible to see how one light can be added to another light and produce darkness, which is sometimes the case; while, if it were motion, we can readily see how motion may be added to motion, and the result be rest. A sound can be so added to a sound as to produce silence, but the more familiar illustration is with waves of water. Two stones dropped into water will produce waves, and where these meet there are points at which the water remains at its original level. This is because at these points one set of waves tends to raise the water while the other set tends to lower it, and between the two it remains where it originally was. This occurs in some parts of the ocean where the tidal wave sweeps around an island and meets, one wave being half a length behind the other, in which case they simply neutralize each other. Where the crest of one wave would have been, the trough of the other would have been at the same time, and between the two impulses in opposite direction at the same moment the water remains unmoved, and there are no tides.

Darkness corresponds with this unmoved plane of water, and with silence in the case of sound-waves. If light were simple waves, as a result of such interference we would simply have darkness, and as a result of partial interference we would have all the gradations from darkness to light; but a light-wave is not a simple undulation, it is made up of innumerable vibrations of various wave-lengths, each of which corresponds with a color or tone. The resultant of all these motions combined is white light. Extinguish one rate of vibration, say the smaller waves which cause the sensation of blue, and we have a wave the resultant of all that is left behind, which will be yellow. Color is a partial extinction of light—not of light as a whole, but a suppression of one of its constituents. If you take a yellow glass and allow the light to fall through it, you will find it transparent; in the same way a blue glass is transparent; but if these glasses are the complementary blue and yellow color, and placed one on top of the other, no light comes through them. The yellow glass sifts out all the blue rays, and the blue glass sifts out all the other rays, and no light can get through. If the colors are not pure, it is usually because the yellow has some green in it, and so has the blue. Neither the yellow glass nor the blue is competent to sift out these rays, so we see green come through them both. This is the case in mixing blue and yellow in paints: the resulting green does not come from the mixture, but is the sediment—you might almost call it—left after the pure blue and pure yellow have neutralized each other.

It is clear that, if two waves can be made to set into vibration the same medium at the same time, and from almost exactly the same center, one of them being a half-wave or several half-waves' length behind the other, we shall have, as in the case of water and sound, no movement, or darkness. If there is not exactly a half-wave's distance between them, some color-waves will neutralize each other and be extinguished, and we shall get the complementary color—the resultant of all that is left unneutralized.

This is the cause of all the flitting and changing colors in soap-bubbles, mother-of-pearl, peacocks' plumage, opals, and iridescent glass. By some means certain vibrations have been extinguished by interference, and we see the resultant of the rest. Whenever light goes from one medium into another, even when both media seem perfectly transparent, there is a partial reflection from the surface where the media meet. Hold a pin against the surface of a piece of glass (unsilvered plate glass is the best): you will see two faint reflections of the pin, one from the front surface of the glass and one from the back, and yet the main part of the light reflected from the pin goes through, as you can easily tell by looking through the glass at the pin. So it is with a soap film: when light falls on it, most of it goes through, but there is a slight reflection from the outer surface of the thin lamina of soap-suds and another slight reflection from the back of it. The two sets of reflected waves start from points so very near each other that they both act on the medium in different directions at the same time and in the same place, and we have color.

If light went forward like a regiment of soldiers in line, there might be just as much interference from the plate of glass as there is from the film of soap-suds; but it does not—it goes out in circular or, rather, spherical waves in every direction from the starting-point. It is only waves of light which are reflected back from two points very, *very* near each other, which produce the colors of interference. Circles which do not have the same center cut each other only at two points; but, the nearer the two centers are, the more nearly the circumferences coincide. When the light comes back colored from a piece of mother-of-pearl, it is because the waves are reflected back from lines so close together that you can not see them, except under a very high power of the microscope, and so they interfere. Metal may be ruled with lines that give back the same sort of color, and perfect impressions in black sealing-wax of the colored pearl will show colors in the same way.

The colors which flit over the surface of a soap-bubble each tells the story of the thickness of the film at that point. These films are exposed to the movement and drying effects of the air, and to the irregular puffs of air entering from the mouth in blowing them; but if a film can be secured from these influences and allowed to become gradually and evenly thinner, even and regular colors appear. Blow a soap-bubble in a watch-glass filled with the soapy fluid. Let it sit in a saucer in which there is also some of the fluid, and cover with a clear glass tumbler the instant the bubble a little overhangs the watch-glass. The soapy fluid in the saucer prevents the air from getting in or out of the tumbler. Such a bubble blown from soap-suds made of distilled water and white Castile soap, which had been standing a very long while and become crystal clear, lasted for three hours and a quarter. It had no colors upon it when covered. They began to form at once: broad bands of pink and green slipped down from the apex; then came closer and more vivid rings of color; at last a black spot appeared, which grew in size. In the long-lived bubble just spoken of, the whole upper part became a metallic gray, covered with clouds of darkness and velvety black spots, the colors being crowded from the apex down to the edges. That these appearances are all due to interference is proved by the fact that, when the light by special means is prevented from reflection at one of the surfaces of the film, the color disappears.

There is no special advantage for home experiments in having a bubble last so long. Very much the same changes occur in a bubble which lasts for half an hour as in one that lasts for three hours, only they occur more quickly.

The colors of films are rarely, if ever, pure prismatic colors; they are the resultant of certain colors left after the extinction of others. Various shades of green, from almost gold to the intensest emerald green, orange dusky with red, red magenta-colored from the admixture of blue waves, and so on, are the colors seen.

Another simple and very interesting experiment is to twist a copper wire into the shape of a tennis-racket or battledore, dip it into the fluid and set it upright under the tumbler. If the saucer is partially filled with yellow beeswax, melted and allowed to harden, this can be very easily done. The colors in this case come down in bars, in the same order as they did on the bubble; the black spot is much larger and more irregular in shape. In one instance, with a simple soap solution, this spot of intense black covered three quarters of the frame before the breaking of the film. Many films may break before one is secured which will last so as to show these effects.

The cause of these regular rings and bars of color is that the film gradually thins from the top, by the slow streaming off or evaporation of the suds from the film, and for each definite thickness a definite color appears. The black spot which comes last of all shows that the film at that place is just one half a wave-length of light in thickness, a size entirely too small for our conception, though it can be told in numbers. The length of a wave of red light is about $\frac{1}{37000}$ of an inch, and of all the other colors smaller.

The circulation and changes in the film are most curiously revealed by the movement of flecks of color on its surface.

There are other ways of making inequalities in the film, which are revealed by the colors. A little instrument, called the *phoneidoscope*, which may be either bought or very easily made, shows most beautiful figures which start into shape in answer to musical notes sung or words spoken into it. It is in all its forms a modification of, or improvement upon, this idea: an inch tube of India rubber of any length, with a funnel on one end and a mouth-piece on the other, diaphragms of thin metal or varnished cardboard being placed across the mouth of the funnel with holes of various

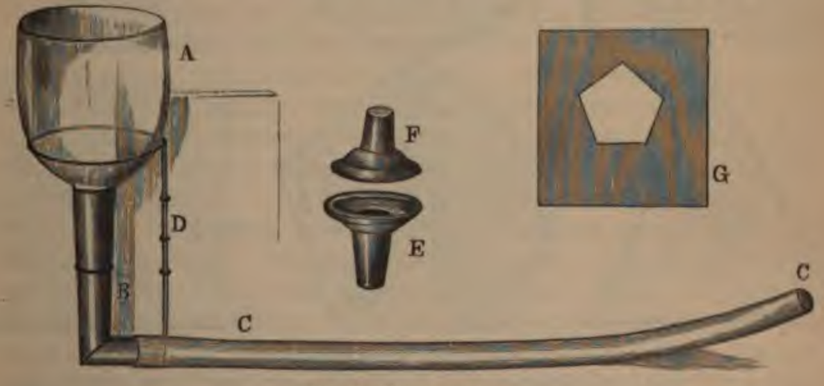

FIG. 8.—PHONEIDOSCOPE.

A, bell-glass; B, elbow; C, India-rubber tube; D, wire support; F, upper half of mouth-piece; E, lower half of mouth-piece; G, diaphragm.

shapes cut in them to sustain the film. A very satisfactory one may be made with very little trouble and at slight cost: three feet of inch rubber tubing, a bell-glass, such as is used to shade night tapers, some pieces of cardboard or thin brass, which can be cut with the scissors, and an inch tin elbow, used in speaking-tubes and costing three cents. Fit the parts together as in Fig. 8. The diaphragms should be blackened and varnished if of cardboard; the holes in them can be triangular, square, round, or of any geometrical shape. A film is drawn across the hole in the diaphragm; it should be set upon edge till the colors are established, then it is to be laid across the mouth of the bell-glass, and into the other end of the tube notes can be sung; but the breath must not be inhaled or exhaled carelessly, or the film will be broken.

A closed mouth-piece may be made by filing off two tin toy trumpets two inches from the *open* end. Over one tie a stretched membrane of India-rubber sheeting, such as dentists use, or fasten with paper a thin sheet of mica, E, or even tough, strong letter-paper may be used. Hold the second trumpet, F, reversed against this, and sing into it.

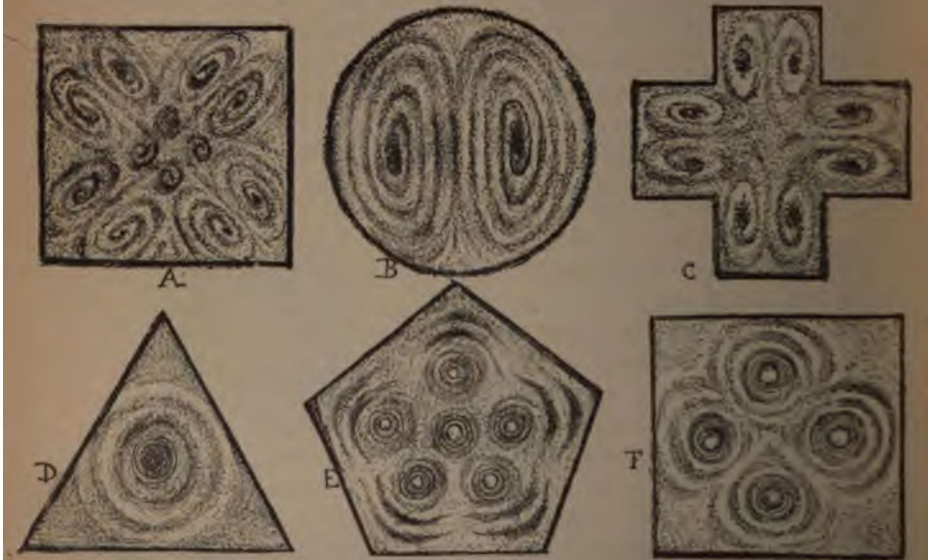

FIG. 9.—FIGURES ON FILMS IN PHONEIDOSCOPE.

A, B, C, forms whirling and evanescent; D, E, F, forms which remained for some time after the vibrations of film ceased.

The colors and figures on these films, if one is patient and learns how to use the voice, are simply incredible—they are so wonderful and gorgeous. Fig. 9, A, B, C, D, E, F, show the forms obtained on several diaphragms with the home-made *phoneidoscope* described above, some with the closed mouth-piece and others by simply carefully singing into the rubber tube. The colors change constantly, and are so rich and gorgeous that they seem to have lost their transparency and to be metallic plates, except for their streaming, swirling colors. The diaphragms should, as was said before, be blackened, and the film seen projected against a black background. I simply use a piece of black material placed behind and a little below the bell-glass on which the diaphragm rests.

These interference colors do not require a film of any special substance, or, indeed, of any substance at all. The air between two plates of clean, clear glass, pressed together and worked with the fingers till they are as close as possible, gives beautiful rings and fringes of color. A crack in the center of a block of clear ice, where there is not even air, but only empty space, or, rather, the ether that fills all space, gives out gorgeous colors of interference.

The colors of iridescent glass are due to interference. In its manufacture, by some chemical means, the surface film has been made different from the glass below, and so acts as the soap film does, and gives out its lovely tints. A drop of turpentine on the surface of water on a black tray shows fringes of color from the same cause.

One of the most beautiful examples of interference color may be seen at the Metropolitan Museum of Art in New York, in the Cesnola collection of ancient glass. Originally this glass was evidently ordinary transparent glass. From some cause the surface has been acted upon till it lies in thin films one upon the other, sending back to the eye the most gorgeous interference colors. By the courtesy of Dr. Isaac Hall, the curator of the museum, I was enabled to examine some fragments of this glass microscopically.

The whole surface is made up of a series of films of the most exquisite delicacy. There are tiny cavities united by a network of lines from which the decomposition has spread laterally in every direction. Flakes come off with the lightest touch, so thin that it seems impossible they should be capable of subdivision, and yet a good two-thirds glass (about one hundred diameters) shows it to be made up of a number of superposed plates. The fact that the color of this glass is due to interference is proved by putting a drop of alcohol or oil upon a flake, when the colors disappear or are entirely changed. As the liquid dries, the colors gradually come back.

The beauty of this glass under the microscope is simply indescribable. Gold and silver, exquisitely wrought, and vivid with every known jewel, would be tame and colorless beside it (Fig. 10, A). The films, as they come off, are in many cases not ordinary flat films; the outlines are sometimes very singular, being made up of most eccentric curves in all sorts of combination. In one or two instances these scales overlapped, showing that the disintegration had taken place in a spiral direction (Fig. 10, B). This world of beauty, in both colors and form, was found within the area of one square inch or less, on a small fragment of no special brilliancy to the naked eye.

Brewster describes, in the "Transactions of the Edinburgh Royal Society," some specimens of ancient decomposed glass, but they must have been in a much earlier stage of decomposition than the Cesnola glass, judging from the figures and descriptions given. He states that the experiment had been made of submitting glass to powerful solvents, when, in a short time, circles and other forms, centers of decomposition, began to appear. Here was probably the suggestion which has since been followed in the manufacture of our modern iridescent glass. In a piece of iridescent glass, brilliant at first, but which has been growing more brilliant for several years, I find a number of distinct centers of disintegration, showing the process, whether by art or by time, to be identical in kind.

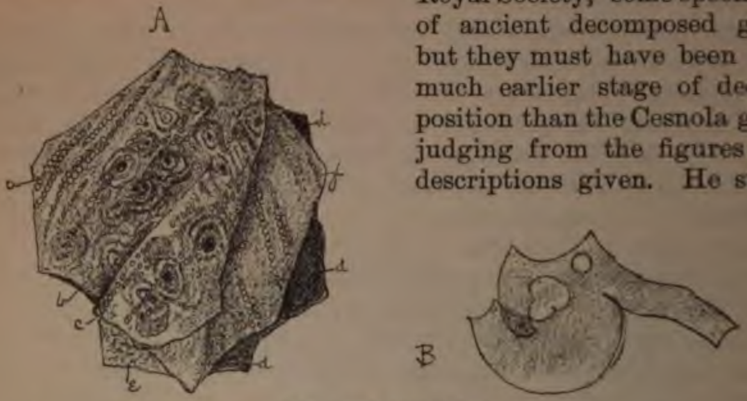

FIG. 10.—CESNOLA GLASS.

A. *a*, emerald-green, with strings of bubbles light-green and brilliant, like pale emeralds; *b*, bronze-gold ground, spots of violet, and bronze-gold rings, ruby, pale vivid blue, and deep sapphire blue; *c*, partly scaled film, vivid violet, toning down, with spots as above; *d*, deep violet-blue, like the sky on certain nights; *e*, speckled gold; *f*, exquisite violet, with bubbles like pearls, only shaded violet tone.

B. Shape of violet layer as it came off, very thin.

THE question involved in the problem of air navigation is regarded by Mr. E. N. Lewis as simply one of increasing power without increasing the weight of the apparatus by which the power is applied. The supposition that the vehicle must be lighter than the air, on which experiment has mostly proceeded, is a mistaken one. "A bird can fly, not because it is comparatively light in weight (for it is not), but because it is strong." The successful air-ship will be a large structure, very light in weight compared with its strength, but many times heavier than the air it displaces, and propelled by machinery capable of developing enormous power. "The skill which has produced . . . the modern bicycle will not find the task of *designing* such a structure too difficult."

THE PSYCHOLOGY OF PREJUDICE.

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THE rapidly enlarging field of modern psychology makes it possible to discuss some questions not before attempted by students of mental science. There is, however, even yet, one apparently simple problem in mental pathology which the most hardy philosopher would hardly hope to solve. This problem is to determine, by analysis of the soul, the causes, symptoms, and cure of narrow-mindedness, or mental bias. Such a research, if aught could be made of it, would be as fascinating as it would be fruitful.

My present attempt is less ambitious. It is to trace out some primary laws of psychic activity in their bearing on that condition of mind known as prejudice. I shall not here allow myself to be entangled in a metaphysical puzzle by attempting an accurate definition of prejudice. To define it as deflection from truth would be to raise the ancient question, What is truth? It will be quite sufficient for my purpose to consider prejudice as individual deviation from the normal beliefs of mankind, taking as the standard the universal, the general, or the mean.

The chapter in modern psychology which furnishes the principles in quest is the chapter on apperception—really only another word for attention. All knowledge is the result of the union of two factors, one objective and one subjective. To know anything is to refer it to something known before. In every cognition there is a union of the group of sensations composing the object with a group of ideas previously acquired and now recalled. Knowledge is classification. The class is within us; the thing to be classified is without. A piece of sugar lies before me on the table. I perceive only that it is a white object of a certain form. I apperceive, by means of the group of ideas previously associated with such white substances, that it is also sweet, hard, heavy, soluble in water—in fact, that it is sugar. The inner group of ideas varies indefinitely in complexity. Closely related ideas may be altogether wanting, as when one sees, for instance, a horse for the first time, and can only ask, What is that thing? or, What is that animal? One with more experience—that is, with more related ideas—apperceives that it is a horse. A jockey, however, apperceives all his "points"; a zoölogist still more. We say that the jockey or zoölogist really *sees* more in the horse than the ignorant man, yet the image made upon the retina of the eye is the same in each observer. Similarly, in reading, we cast the eye rapidly down the page and, although we do not see one half the words, or a fraction of the letters, yet we catch the sense. If it happens to be a letter from a well-known friend, we read also, as we say, between the lines. Really we read out of our own heads.

The subjective or *a priori* factor is simplest, therefore, when, as in the cases given, it is merely the class notion, horse or sugar; it is most complex when it represents, for instance, a whole system of astronomy, as when, in a falling body, there is apperceived a law of gravitation. But, simple or complex, it follows, first, that unless there be an inner group of ideas to which the object may in some way be referred, knowledge of it is impossible; and, secondly, that the character of the resulting knowledge depends upon the character of the inner group of ideas. You and I, therefore, see everything to some extent differently. You see things from the standpoint of your previously acquired groups of ideas; I from mine. Strictly, no two persons can see the same thing in the same way, for it can never happen that two persons have precisely the same groups of ideas relating to any subject. These depend on our past experience, on our education, on the beliefs of our times, on our various sects or parties, on our pet theories, our interests, and our desires. Here is a simple illustration. Suppose an artist and an engineer, standing side by side overlooking a tract of country. What they perceive is the same; what they apperceive is wholly different. To the engineer the country presents itself as a possible line for a railroad, with here advantageous grades and there economic bridges. Before the artist is spread out a landscape, with light and shade and harmony of colors. Suppose, again, a plot of level ground in the suburbs of a city. A college student riding by apperceives it as a possible ball-ground; a young girl, as a tennis-court; a speculator, as an addition for town lots; an undertaker, perhaps, as a possible site for a cemetery.

In the primary laws of knowing, above stated, we discover the ground principles of the psychology of prejudice. The results may be summed up in the form of two laws:

1. *We see only so much of the world as we have apperceptive organs for seeing.*

2. *We see things not as they are but as we are—that is, we see the world not as it is, but as molded by the individual peculiarities of our minds.*

Applications of the first law I shall state briefly; of the second, more in detail. The eye is limited by its structure to the reception of ethereal vibrations between the colors red and violet. The ear converts into sound only air-vibrations of a limited rapidity. Just so the mind, in its reception of knowledge, is limited by the quality and amount of its previous acquisitions. "No man," Emerson tells us, "can learn what he has not preparation for learning, however near to his eyes is the object. A chemist may tell his most precious secrets to a carpenter, and he shall be never the wiser—the secrets he would not utter to a chemist for an estate. God screens us evermore from premature ideas. Our eyes are holden that we can not see things that stare us in the face, until the hour arrives when the mind is ripened; then we behold them, and the time when we saw them not is like a dream." Instinctively, therefore, we seek the mental food that our minds are prepared to digest—that, namely, which is most clearly related to what we know already. In conversation, notice how people brighten up when you tell them something that they know already, especially if it is something they have long believed or themselves discovered. In society we know how to make ourselves agreeable by speaking to each person on the subject of his peculiar interests. If we are wise, we shall engage each person in subjects of conversation about which he is best informed. By so doing we can not only make ourselves agreeable, but lay by a stock of useful information at the same time. Such a course is by no means easy. We fall naturally into the vice of parading our own knowledge, and we like to hear others talk, not of their interests, but of ours. Sometimes persons in conversation act simply as foils each for the other. I listen to your stories only that you in turn may listen to mine; and in the next company I tell not the ones I heard, but the ones I told before. Thackeray, in "Henry Esmond," hits upon this human weakness. "They emptied scores of bottles at the 'King's Arms,' each prating of his love, and allowing the others to talk on condition that he might have his own turn as a listener."

We like also to read that which favors our side of a question. The Republican subscribes for a Republican newspaper, and the Democrat reads the organ of his party. In the last political campaign it was no doubt true that advocates of free trade or of tariff reform, and advocates of protection, read for the most part literature favorable to their respective views. The churches plead for greater consensus of opinion, yet the Methodist subscribes for a Methodist paper, the Baptist for a Baptist paper, the Roman Catholic for a Catholic paper. In general we read the organ of our own sect or party. There are, of course, some valid economic reasons for so doing. I shall speak of these reasons below. But, if truth alone were sought, the plan we pursue would be the worst plan possible. Sometimes even we indignantly refuse mental food that might serve as a corrective of our possible one-sidedness, instinctively avoiding that which we feel can not be assimilated without a dangerous readjustment of our mental possessions.

The skeptic in religion opens a book on Christian evidences, only to close it in haste when he perceives its trend; while the pious believer, who picks up the work of Strauss or Renan, drops it like a burning coal. We avoid books, men, sermons, society, that are not, as we say, congenial. Hence the trouble we have in getting our books read by the very people for whom they were written, or in getting our articles printed in the journals that circulate among the readers we desire to reach. The preacher prepares a vigorous sermon for "sinners," but he preaches it to his own devout people; the "sinners" are not there.

Our psychological law of prejudice thus developed teaches us that, since we seek not for what may correct our possible errors, but for what will confirm our already acquired opinions, our mental life always tends toward intensification or *involution*. Evidently this tendency of the mind toward involution will grow with age, and our every-day experience confirms this deduction. Teaching new tricks to old dogs is easier than giving us new apperceptive organs when middle life is past. The old man changes his politics rarely, his religion never. He lives from within. The mind becomes more and more a microcosm. The cerebral tracts show well-beaten paths of association. The brain becomes hardened and fixed. "An old man," says Dr. Holmes, "who shrinks into himself, falls into ways which become as positive and as much beyond the reach of outside influences as if they were governed by clock-work." The brain, he continues, has its "systole and diastole as regular as that of the heart itself."

"Minds roll in paths like planets: they revolve
This in a larger, that a narrower ring,
But round they come at last to that same phase,
That self-same light and shade they showed before.
I learned his annual and his monthly tale,
His weekly axiom and his daily phrase.
I felt them coming in the laden air,
And watched them laboring up to vocal breath,
Even as the first-born at his father's board
Knows ere he speaks the too familiar jest
Is on its way, by some mysterious sign
Forewarned, the click before the striking bell."

The older we get, the larger becomes the subjective factor of knowledge and the smaller the objective. We are, as said the obscure sage of Ephesus, like those asleep, withdrawn each into a private world of his own. We can now understand that state of mind described by the word "confirmed." We hear of a confirmed pessimist, a confirmed protectionist or free-trader. Sometimes we apply the word without shame to ourselves, saying that experience has confirmed us in this or that opinion, not knowing that to a considerable extent we have selected our own experience.

Our second law affirms that we see the world not as it is but as modified by the individual peculiarities of our minds. The illusions that result are Bacon's well-known "idols of the den," doubtless the most fruitful of the four sources of error pointed out by that clear-headed philosopher. For our starting-point we may turn again to physics and physiology. Vibrations of the luminiferous ether of varying rapidity are perceived by the eye as a harmony of colors. Vibrations of the air of varying rapidity are perceived by the ear as a harmony of tones. Unless, now, we are prepared to say that the *colors* red or green, or that the *tones* a or a′, are like or in any way similar to the *motion* of the ether or air; unless, further, we are prepared to say that, corresponding to the subjective *harmony* of colors and tones which we feel, there is an objective *harmony* of motions in the ponderable stuff, then we must admit that we have here cases of the great primary illusion of a phenomenal world of ideas like a noumenal world of things-in-themselves. With this ancient problem of perception we are not now concerned, but it serves as an illustration of our mental law of apperception. As the eye and the ear, each according to its structure, make over the manifold motions of the external world into sensations of light and sound, so the mind makes over the materials of knowledge into this or that product according to its peculiar constitution. Observe, however, this difference between the two cases. While the eye and the ear vary little in structure in different individuals, the variations in mental structure are endless, being determined by our environment, education, and inherited peculiarities. Color-blindness is comparatively rare and limited to a few colors; psychical blindness, in a greater or less degree, is a defect no man is free from.

The simpler illustrations of this law need not detain us. We put any new phenomenon into that class of our previous notions which it most closely resembles. A child who sees a cow for the first time calls it a horse, if familiar with horses. The same plant may be apperceived by a girl as a flower, by a farmer as a weed, by an old woman as an herb. The story of the precocious boy is in point. He sat under a tree as three strangers passed by. The first said, "What a fine stick of timber!" "Good-morning, carpenter," said the boy. The second, "What excellent bark!" "Good-morning, tanner." The third, "What a beautiful treetop!" "Good-morning, artist." He had correctly interpreted their vocations from their manner of apperceiving the tree. Our habits of thought, once started, grow on any food. We go by chance to hear a lecturer of an opposite party or sect, and come away confirmed in our *own* views. This law of mental inertia tends constantly to produce one-sidedness. Nature strives ever to rectify this tendency by presenting to us an unsorted variety of details, and succeeds in keeping most of us within the bounds of sanity, though not of perfect balance. "The complexity of our environment," says Ribot, "is our safeguard against automatism." But our ideas are ingrowing, and need to be constantly watched and corrected. Insanity is a matter of degree. When the "fixed ideas" which few of us are without pass a certain point and get too obtrusive, we become monomaniacs. Men of one idea, men of mental bias, narrow-minded men, present milder cases of the same disease.

Fruitful illustrations of this law may be seen in the *systems* of thought that have prevailed since the days of Pythagoras. Systems of words would be a better name for many of them. As in our seeing, so in our thinking, we are limited by the apparatus that happens to be at our command. For most of us, at least, the available apparatus for constructing a philosophical system is a philosophical vocabulary. From this fact and the further one that these vocabularies are largely inherited from the schools, it results that the apperceptive organs of metaphysicians are wofully inadequate to the task they undertake, namely, the cognition of ultimate realities. It is no wonder, therefore, that these realities have been persistently apperceived under so many different forms in the various metaphysical systems, supported by so many "hide-bound adult philosophers." Many a well-meaning philosopher has got caught in the swing of a certain terminology, till his thoughts have become slaves to the movements of his tongue. We are reminded of Aristotle's categories, Kant's map of the mind, Comte's three stages, Hegel's thesis, antithesis, and synthesis, the absolute and the finite, subject and object, mind and matter, body and spirit, noumenon and phenomenon, real and ideal, rational and empirical. This is the "tyranny of formulas" from whose iron rule science is now escaping, but which is still the terror of philosophy and religion.

The danger of words and formulas may be well illustrated further by the mischief made in philosophy by the presence of negative terms. These are the words which in the finished systems of the philosophers mark, we may say, the absence of thought. We recall the "*In*finite" of Zeno and Kant, the "*Ab*solute" of Fichte and Hegel, the "*Supra*-essential" of Pseudo-Dionysius, the "*Un*conditioned" of Hamilton, the "*Un*knowable" of Spencer, the "*Not*-ourselves" of Matthew Arnold, the "*Un*conscious" of von Hartmann, the "*Im*mortality" of Christian believers, the μὴ ὄν of the Greeks, and the "*Non*-being" of the Hegelians. These represent the unfathomable places in thought, which we bridge with a negative term and pass on blithely as before, but presently find ourselves using them as conceptions regularly formed. In Goethe's well-turned phrase:

> "Denn eben wo Begriffe fehlen,
> Da stellt ein Wort zur rechten Zeit sich ein."

But if prejudice prevails in philosophy, what shall we say of religion? The race as a whole is divided into a large number of religious systems, and each system into sects. Every individual apperceives the "eternal truths" from the standpoint of the sect in which he was educated. Rarely does he change from one faith to another, and when he does so it is not often for his peace of mind. Such an "Exodus from Houndsditch," in Carlyle's homely phrase, is accomplished only "in a state of brutal nakedness, scandalous mutilation." Why? Because religious ideas are deep-seated and fundamental. To receive into the mind a group of new and foreign notions of such a kind requires a breaking up and readjusting of the old order such as few can undertake with safety. The very psychological laws that we are studying, however, may teach us that these world-wide differences in opinions are not destructive of the eternal verities of religion, but only that these verities are distorted when narrowed down to fit our particular systems and our individual capacities.

There is a curious science called the science of interpretation, whose business it is to translate the facts and thoughts of the world into phrases comprehensible to a mind limited to a certain system of ideas. Have we ever stopped to think what a confession of shame such a science carries on its face? To interpret is, in some sense, to change, to distort. An instructive illustration of this branch of learning may be seen in hermeneutics, or the science of the interpretation of the Scriptures. Never in any literature were thoughts expressed in so simple, straightforward, and honest language as in the books of the Bible, or in language less in need of interpretation. What this science really has in hand is the pitiful task of fitting a vast variety of thoughts into the limited number of forms of some system of theology. So, everywhere, it is a mistake to interpret things. It is better to let Nature carry on her work of rectification, by allowing the bare facts of the world to project themselves freely against our minds and be perceived as they are, or make for themselves apperceptive organs.

Interpretation leads to over-interpretation. This evil becomes prominent in connection with those studies which are not yet exact sciences, such as sociology, ethics, metaphysics, and theology. Here, as we know, we very often have to make an allowance for the "personal equation" of the author—unless, unfortunately, belonging to the same party, sect, or school, we have blindly accepted him as a guide. We understand that he writes from a certain *standpoint*, and that unconsciously and inevitably he will see things, not just as they are, but as tinged by his own subjective light. Where, for instance, shall we find a perfectly just history of philosophy? Not in Schwegler, who glances over the past through a pair of thick Hegelian spectacles; nor in Lewes, who apperceives the opinions of thinkers with a positivistic bias. Theology is quite a different science as presented by a St. Augustine and a Pelagius, by a Protestant and a Romanist. The Socrates of Grote is not the same man as the Socrates of Cousin. Jesus, even, is seen in an entirely different light by Fleetwood and by Renan. The Greek thinkers, especially Aristotle and Plato, have suffered much at the hands of modern writers, being used as props to bolster up every man's system of science or philosophy.

Over-interpretation is really only the logical outcome of another wide-spread evil, that of over-systemization. This is a prevalent modern vice. It is the abuse of classification, or the scientific method. It is the tendency to group under any outlined system or theory more facts than properly belong to it. We fall in love with our favorite theory, and it seems to us to possess exaggerated virtues, and to be able to explain all phenomena. Darwinism in biological science, utilitarianism in ethics, and Hegelianism in philosophy, are examples. The latter is a very beautiful illustration of over-systemization. Hegel, with his thesis, antithesis, and synthesis, fondly thought he had spread a net that should capture the universe. But the strain appears to have been too great, and already we see the ruins of a great collapsed philosophy. Over-systemization is apparent also in the present rage for publication, especially in Germany. Every university man must publish a book, and every book must present either some theory or the results of some original research. Under these circumstances, it is not surprising that the demand for new material exceeds the supply. The result is, that the author falls back upon his own mental resources. He makes a new and original hypothesis and apperceives his facts to fit his theory. Adopting, as it would seem, the maxim that it is better to be original than reasonable, it is considered no disadvantage if the new hypothesis is somewhat fanciful and startling, as for instance that Schiller, not Goethe, was the author of "Faust," or that Shakespeare's plays were written by Bacon.

I have explained the narrowing effect of "schools" and systems, and the mental bias which results from over-systemization; but the use as well as the abuse of systems must not pass unnoticed. There is good in them as well as evil. Trendelenburg says that a system is as necessary for a thinker as a house. We must get our knowledge into some sort of unity, otherwise it can neither be retained nor used. The Ptolemaic system of astronomy was far better than none; it served as a framework for a great body of facts, distorted though they were by the false theory. We are lovers of systems. Most of us prefer unity to verity. We want order and discipline among our ideas. Of absolute truth we can not speak; of order and consistency we may. Any new system may find numerous adherents, if only it be presented in the threefold form of unity, consistency, and repetition. It is easy to understand this love of systems. They save us from the inevitable mental bankruptcy which would result from the influx of a mass of uncoördinated impressions. Grant us a system, all complete in its several compartments, where we can pigeon-hole each newly acquired fact, and peace and harmony reign within. No matter if the system be so narrow that we can dispose therein only a limited number of impressions; if only we have confidence in it, all heterogeneous elements we may cast out as "error." We love harmony and hate antagonisms. It is mental economy, therefore, for us to read the organs of our sects and parties, to converse with those with whom we sympathize, to listen to that which we believe already. Great historical disturbances bring out systems. It is in this way that we get ourselves ready for troublous times. A system is a kind of mental fortress, a vantage-ground from which to scrutinize each new idea, and apperceive it as a friend to be received or an enemy to be, on *a priori* grounds, repelled. System-forming is thus the process of mental involution, which is the law of individual minds, as evolution is of the mind of the race.

Mental involution shows another phase in *habit*. Habits are well-knit associations. They make us machines, committed forever to a determined manner of acting and thinking. A habit is itself a mental bias. Stereotyped and inherited, it becomes instinct, where we see the full fruition of the involution movement and the dead level of automatism. From this point of view, instinct has been well called "lapsed intelligence," if by intelligence we mean power to adapt ourselves to new surroundings and to avail ourselves of new impressions. Habit is opposed to progress. In history, our reformers—Jesus, Savonarola, Luther—have been habit-breakers. Genius, too, is only the name of that disposition which rebels against the law of mental involution, breaks away from systems, and goes out in search of the objective truths of nature. Thus, side by side with the involution movement, we find the evolution movement. In the animal kingdom, it is represented by the persistent but mysterious tendency toward *variation;* in human history, by the comet-like appearance of the reformer; in art, by the lawless product of genius. All these are factors in the upward world-movement which saves us from the stagnation of the relentless law of habit.

But habits, like systems, have their good side. They enable us to do a vast number of actions with the minimum of attention and the least expenditure of nervous energy. Education consists largely, as has been said, in making habitual as many good actions as possible. The training of domestic animals is purely the formation of good habits; the training of children is largely so. Every time we form a good association and send it down into the region of the unconscious, we practice mental economy. Habits, therefore, are at the same time our salvation and our damnation. This is the great dilemma in education. Extremists like Rousseau, impressed with the danger of habits, condemned them all outright. Perhaps we may say that it is the abuse of habits, the falling into fatal ruts, that constitutes our prevailing sin.

The laws of prejudice that we have examined naturally suggest one or two questions. Is there any escape from this narrowing of mind that accompanies the hardening of the brain? If not, are there any pedagogical principles the application of which in educational systems may retard the involution and hasten the evolution movement? It is not my purpose to attempt to answer these questions here; but, if the first one must be answered in the negative, the latter may certainly be answered in the affirmative. Our psychological principles have already shown us the direction in which the solution of this problem must be sought. There must be persistent emphasis of the objective factor of knowledge. The senses, the primal source of all our knowledge, must be kept open and alert. This is vastly more difficult than at first appears. The man prejudiced by his interests has his eyes and ears open, and yet, being open, they are shut. More than twenty centuries ago an old Greek philosopher said, "Eyes and ears are bad witnesses to men having rude souls." To escape mental bias, we must not only have our senses open to the outer world, but we must apperceive this world as it is, not as warped by our receptive faculties. But, however excellent this advice, it is as impossible for us with minds already formed to follow it as to see the ultra red or violet colors with our eyes constituted as they are. The remedy is to be found in education, especially of the young. Fortunately, we live in an epoch of objective education. The training of the senses, thanks to the labors of Rousseau, Pestalozzi, Froebel, and their disciples, and thanks to the retroactive influence of the physical sciences, is now the great central thought in pedagogical systems. Unfortunately, it is still too largely theory and too little practice. In our primary as well as in our secondary schools we slip back too easily into the lazy scholastic, deductive methods. The tendency, however, is the other way.

Our free press, also, and our free speech are great educators. In these days we are compelled to see and hear and think. The narrow-minded man is unhappy and distracted. He is no longer protected in his little system by college or cloister walls. A myriad unwelcome facts peer in at him from every side—from the circulating library, from the interesting novel, from the omnipresent and iconoclastic newspaper. The man of mental bias is veritably a victim of persecution. Optimists tell us that the world is growing honest. I am optimist enough to believe that it is growing broad-minded. Perforce it must. The air is full of everybody's ideas. They circulate everywhere and act as a series of incessant shocks wherever they find a mind too narrowly planned to admit them. Hence men are beginning to avoid systems as the cause of more friction than they save. They are willing to sacrifice a narrow love of unity and consistency for a broader harmony with the spirit of the age.

What is likely to be the result of this general breaking up of old unities, systems, habits? An increase of insanity? By no means. Insanity proceeds from the opposite movement, from the involution of the mind upon itself, till fixed ideas can no longer be rectified by objective facts. The results will be good and bad: good, in encouraging inquiry and in substituting the love of truth for the love of consistency; bad, in discouraging a certain moral earnestness and enthusiasm which are the outgrowth of strong conviction, for the narrower is one's system of thought, the stronger often are one's convictions of its truth and importance. The extreme form of this union of prejudice and intensity we call fanaticism. If not in fanaticism, at least in enthusiasm, there is an element of good which we must not overlook. Men possessed with one idea are men of action. Enthusiasts carry forward great movements. The development of the intellect is the weakening of the will. Children and animals act out every thought. Education is a training in the inhibition of movements by the higher intellectual processes. The man of many-sided mind finds every volition "checked" by some antagonistic idea. The correction of mental bias, therefore, will result in a certain loss of spontaneity. But progress will not suffer. If we move more slowly, it will be more surely. What we lack in enthusiasm we shall make up in balance.

"The great fault of non-manual training schools," says Prof. C. M. Woodward, "is their haziness. The pupils look at multitudes of things but do not perceive them. Having eyes, they see not; and having ears, they hear not. There is too much that is dim and muddy and feeble. Substances elude the grasp; shadows, uncertain and fleeting, are too often the only results. The method which reason and experience both approve is reversed, and pupils are put to committing to memory matters which they are not prepared to understand."

ORIGIN OF LAND-OWNERSHIP.

By DANIEL E. WING.

IT has been asserted that nothing is so devoid of natural justice and moral right as private ownership in land—the sole dominion over a portion of the earth's surface which one man claims and exercises to the exclusion of the dominion of every other man therein. The proposition would be true, and private ownership in land would work the greatest injustice that the mind can conceive—human slavery absolute—if it were possible that one man or a set of men with one common motive could appropriate all land. But such a thing is absurd. And it is denied that private ownership in land as now constituted is unjust, or detrimental to the best interests of mankind associated in the social organization of the world.

Let us assume that primarily land was held in common, or a yet stronger proposition, that it is a law of nature that all land shall be so owned and enjoyed. By the same law of nature, and by reason, he who first began to use a particular spot or field acquired therein a kind of transient property that lasted so long as he was using it. The right to use it lasted so long as possession continued, and with death or removal, possession ceasing, the personal right of usage ceased also, and the land was open to the next occupant. That is, whoever was in occupation acquired for the time being a sort of ownership, a *quasi*-ownership for the purpose of subsistence, or rest if you please, and to drive him therefrom by force would be a violation of the same law of nature. But once he quitted it, another, having the same right of use and an equal claim to occupancy, might seize it without injustice. Applying this system to an imaginary or ideal state, to men having a common interest and few wants, and those supplied from nature by the simpler forms of industry, the result is a picture of comfort and competence for every one of the community; in fact, an extensive household, with its respected father or chief, around whom cluster the helpless and inexperienced.

But will any one say that no more stable way of holding land than this is required in a society teeming with population, where each man eager for gain is pressing, pushing, and jostling his neighbor—where the industry of one man may have added to the fertility and usefulness of his land what neglect and sloth have denied to that of another? Every man's hand would be raised against his neighbor, and there would be no domestic quietude or personal security; and, consequently, no social bond, civil government, or commercial life. This insecurity I apprehend to be the *prime* cause of establishing a more permanent property in land

Necessity gave to the occupant more than a mere transient interest. Necessity gave a species of *property* in the soil, and, in order to insure that property, recourse was had to social organization, to laws, and punishments for violation of laws.

Now, when man enters into civil society and partakes of its benefits, he must surrender some of his absolute personal rights, or exchange them, as it were, for such relative rights as are incident to men as factors of society. This is no loss or hardship, for he gains by exchange that security of person and property which it is the object of civil government to insure; whereas, in the natural state, every other man being possessed of the same absolute rights of person and property, there would be no security either of person or property. The rights, then, belonging to a man in civil society, which we will call his civil rights, are the absolute right belonging to him by nature, so far restrained by civil law as is necessary and expedient for the general advantage of the community.

It being evidently natural that man should acquire a right of property in the soil, the next inquiry is, how property became actually vested. As occupancy gave the right to temporary use, so occupancy also gave the original right of property in the thing used. The same law of nature would suggest that the first occupant who had by his industry and thrift added to the utility of the soil—in fact, developed by labor the only value therein—should become the owner. The product of a man's labor, the work of his hands, is his. Whatever he removes out of the condition that nature has left it in, he has mixed his labor with and joined to it something that is his own, and thereby acquires a property in the thing itself. Necessity, arising from insecurity of person and property, being assigned as the first and primary reason for private ownership in land, the right of a man to the product of his labor may be cited as a secondary reason.

Although by theory of civil law as well as by usage, ripening into universal sanction, the ownership of land is deemed to be in private individuals, can it be said, after all, honestly and rationally, that the individual has an ownership of the soil as absolute as in the case of personal property? His interest is rather possessory for the time being, the manner of his enjoyment usufructuary: he can not move the land or carry it with him from place to place; he can not change the nature of it; he can merely draw from its substance for the time being, to the exclusion of all others from such use. In such exclusive use he is as much supported and upheld by natural justice and moral right as in the case of personal property. His labor and capital have improved it, beautified it, rendered it more productive, and enhanced its utility; and, so far as value is concerned, it will be argued hereafter that land has no value except as labor has made one for it. So I suggest the possessory and usufructuary interest of the individual in land is not the absolute ownership and proprietorship of the soil.

Let us see if anything more than occupation, by successive individuals, is contemplated by social law, or by statute law in England or America. In England the proprietary ownership of all land is by common law in the people as represented by the king, the trustee under the social system of all their common interests, rights, and properties. In the United States it is vested directly in the people. By the Constitution and statute of New York State, "the people of the State in their right of sovereignty are deemed to possess the original and ultimate property in and to all lands within the jurisdiction of the State." This I understand to signify precisely what the common law of England and the universal law of nature are: namely, that all property in land was originally vested in the people in common; and if there ever happens a time when no person is in occupation of any portion thereof, the tenancy in common of the whole community immediately goes on again just the same as when, after the first occupant or squatter had relinquished his temporary occupancy, the whole community was again in possession, every man having the right to occupy it, but all in common. So I assert that private ownership, so called, is not a proprietary quality. It extends to and includes only the use; the absolute ownership of all land being, in fact, in the community composed of all individuals.

Suppose that every new-born offspring of that community by virtue of natural right becomes a tenant in common with all individuals then existing, should he share in the possessory right or use of a particular piece of land already in occupation of an individual? By being debarred from such possession, it may be that he is deprived of a natural right, but he becomes a member of the society into which he is born, governed by its laws for the time being, surrendering some portion of his natural and absolute rights for the protection guaranteed by the existing social laws, and participates in all the advantages now existing as well as in the advancement and social improvement of all previous time. Is he, then, defrauded?

The possession of land remains in the occupant by right and justice till such time as he does some act indicating his intention to abandon it, whereupon it becomes common property, and liable to be again appropriated by the next comer. Sale and delivery of possession to a purchaser are forms for the convenience of social government, and instituted with a view, I apprehend, of preserving the quiet and security of social order. By means thereof the present occupant indicates his intention to abandon *the land* appropriated. The deed of conveyance is an evidence of that intention; and the purchaser, being the first acquainted with such intention, steps in and seizes the vacant possession. Thus the act of abandonment gives the new taker a right against the first, acting by what is known in law as an estoppel, and possession or occupancy is by natural law good against all the world besides. The most effectual way of abandonment is by death of the occupant, when both the possession and intention of keeping possession ceasing, the right of occupancy by natural law also ceases, and the land is open to the next taker. The custom, which has ripened into statute law, that the next of blood take on decease of the occupant, has its foundation in natural law instead of mere civil right. A man's children, those of his blood, his nearest relatives, are usually about him on his death-bed, and are presumably the first witnesses of his decease. They become, therefore, presumably and by natural law, the next occupants, until in process of time this frequent usage ripened into social law.

I have gone to this length in discussing the origin of so-called private property in land to ascertain on what support of natural justice and moral right it rests. This consideration is the foundation upon which stands the whole superstructure of proposed single taxation; for, "if private property in land be just, then is the remedy proposed a false one." If the individual has no such property, or the tenure by which he holds occupancy is supported by natural law, and his use of the land is consistent with natural justice, even though it works a wrong to another, the fault is not due to "maladministration of social laws," in this particular at least.

Investigation leads me to assert that the occupant of to-day holds by a tenure as much supported by natural justice and moral right as did the first taker; and more so, because he has, by exchange of his capital, the product of his labor, purchased the improvements added by every occupant preceding him.

Land has no absolute value. In a natural state and unoccupied by man it produces no wealth. It is only as capital and labor are applied to it that it becomes a factor in wealth, and hence acquires a commercial value. I agree to the proposition that what a man makes or produces is his own to enjoy, to use, to exchange, or to give; that no one else can rightfully claim it, and his exclusive right to it involves no wrong to any one else. So, if by his labor and capital man in occupation of land removes it from the state in which Nature has left it, improves it, renders it more productive, or if he acquires by exchange the improvements already made therein by another, he has joined to it something that is his own, and has created a value in it that did not exist before. Admitting the proposition that government, representing in the social state the common rights of the community, may interfere and take the land occupied by such individual, as the whole community acting in common as owners might have ejected the first taker, yet on the principle of natural justice and moral right it can do so only upon reimbursing the occupant for all improvements to the land—that is, for all the product of labor expended upon it, including that which he has become possessed of by purchase. Since all the value in land is due to the employment of capital and labor, such reimbursement should equal the present commercial value of the land to the occupant (owner). Upon this naturally just and moral principle rests the constitutional restriction to eminent domain, that private property shall not be taken for public use without just compensation.

Nor can I see that, because land occupied by an individual may have a value beyond the value of the labor expended upon it, by reason of its proximity to other lands upon which greater wealth has been expended by other individuals, the injustice of deprivation is lessened. The same rule of reasoning applies to this unearned increment as applies to the actual labor value of the land. The present owner has acquired it by the exchange of his capital, which was the product of his labor elsewhere, and it is really as much a value made in the land by the expenditure of capital and labor as that represented by the actual labor of the first occupant. If so, it is included in the present commercial value of the land.

And why should land alone be deprived of this unearned increment? Other possessions receive a borrowed value from extraneous circumstances, such as the occurrence of war, change of fashion, etc., and no one suggests that it is not a true value to which the property or commodity is entitled.

To recapitulate:

By natural law land is owned by all men in common.

The first taker or occupant might rightfully appropriate so much to his exclusive use as a proper use thereof permitted.

His possession, to the exclusion of every one else, might continue so long as he used the land, or *while* he was using it.

Upon possession ceasing, his right to use it ceased, and the land was again held in common, subject to be again appropriated for use.

Insecurity in the use, since the occupant's labor added to the soil what before it was devoid of—a commercial value—necessitated a more substantial tenure, a sort of property in the soil which is called private ownership.

To secure this to individuals, social governments and social laws sprang into being.

These latter, either by common usage long established and acquiesced in, or by express provision, not only recognize but assert the law of nature in respect to property in land.

Sale of land in occupation of an individual is an act indicating his intention to abandon it, a grant or conveyance being the means established by social law to signify this intention.

The purchaser, being the first acquainted with such purpose, seizes the vacant land and is the next taker by natural law. The consideration paid represents the capital and labor expended in the land by all occupants, and the justice of such payment is sustained by every principle of natural law and moral right, since the capital and labor so expended represent all the commercial value that the land possesses.

And, finally, to deprive the individual of his occupancy and possession, although it be to reinstate the owners in common, can only be in natural justice and moral right upon payment of the value of the capital and labor represented in the land, which is the whole commercial value of the land.

It follows, then, that the demands of natural justice and moral right would be ignored if all taxes were put upon land, because one form only of labor and capital would be thus compelled to bear the whole burden of taxation.

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THE GROSS AND NET GAIN OF RISING WAGES.

BY ROBERT GIFFEN.

IN the discussions to which former papers of mine on working-class progress have given rise, there are some criticisms which have interested me very much. They are made by members of the working class themselves, who are slow enough to admit the average increase of their money earnings in the last fifty years which the figures demonstrate. But, admitting some increase of money, they go on to say, and admitting, too, the low prices, the improvement after all is not without drawbacks, or, as I have suggested in the above title, it is mainly in the gross. There are drawbacks which take away much of the apparent advantage. A general statement like this, apart from particular allegations to support it, could not but excite my attention, although I have avoided hitherto any discussion of it. It is a good rule to do one thing at a time. An improvement of money earnings and no increase of prices appeared to be two points worth establishing, whatever the drawbacks of a less apparent kind, and which the working classes could themselves best appreciate, might be. But while avoiding the discussion hitherto, I have been none the less observant, for the simple reason that each class knows its own grievances as no others can, and that such complaints, though [illegible] to prove unfounded, are apt to cover facts which will reward investigation—which will throw light, when properly understood, not only on the particular problems in hand, but on larger problems. I propose in the present paper to communicate some reflections which I have made. The alleged drawbacks, when considered, do, in fact, suggest for consideration questions of a weighty nature, which go to the root of ideas of progress, and affect the most general views of the prospects of modern civilization.

The alleged drawbacks of which I speak are mainly the following: First, it is said, workingmen in many cases have more to pay for rent than they would have to pay when earning less money under different conditions, or they have to pay railway or 'bus fares or similar charges for conveyance to and from their work, which are in the nature of an increase of rent. Consequently, although the money wage is more, the workman is not so much better off than he was, because a large part of that money wage has to be paid as a fine, practically, to enable the workingman to be in a position to earn it. In other words, the gross sum is more, but the net sum is not so much more. It is easy to perceive, also, that this principle may have a much wider application than may at first be surmised. The case usually thought of is that of rent, or an equivalent fine on a workman, which he pays in order to be in a certain place where the money wage can be earned. Suppose the climate in which he has to live in order to earn a larger money wage than he can get elsewhere is so exhausting as to compel a larger consumption of food in order that the money may be earned? The question of gross and net is thus of a wide-sweeping kind.

Next, it is maintained that along with a great increase in production, which has undoubtedly taken place, there has come an increase in the severity of the labor, and that the workman's remuneration has not risen in proportion. It seems to be suggested at times that the increase in the labor is itself an evil, even if it were proportionately remunerated, but the complaint rather is that the severer toil is not adequately compensated; the workman has a severer call made on his energies, and he is not so much better off. To be able to earn more money, it is sometimes urged, he must, in fact, spend more money on food and other things than he formerly did. Here, again, is a question of gross and net, and it will be observed how the last complaint raises in a different form the question already suggested under the first head by a consideration of the effects of climate. A distinction is made between the gross earning and the net surplus, the difference being something which the workingman has to pay as a fine to enable him to earn the net sum which he wishes to spend.

Last of all, it is maintained that on all sides the scale of living has become more expensive. The workingman has to get more food, clothing, and shelter for his family than he would formerly have had to get; more is expected of him; and he has to pay for such things as the education of his children to a much greater extent than he would formerly have had to pay. In this way the strain upon the workingman has increased. As I understand the complaint, he is no more a free man than before. His energies are mortgaged in advance, and he has all the old difficulty to keep his footing in the world.

Now, whether these complaints are right or wrong, well or ill founded, it is clear that they involve problems of a most vital kind as to the general effect upon the working classes of the conditions of modern civilization. To take the first head of complaint. If it be the case that a rise of rent or the charge for traveling between the place of living and the place of work or similar expenditure is sufficient to deprive workingmen of the advantage of increased money wages, then the congregation of men in cities or in certain parts of cities, where higher money wages are to be obtained than elsewhere, which appear to be the conditions of modern industrial life, would be fatal to improvement. It would be the same with the necessity for working in an exhausting climate. The problem, as stated, is certainly of the gravest kind. The questions raised by the second head of complaint are just as important. If increase of toil, not proportionately remunerated—for which perhaps there can be no proportionate remuneration—comes with the increase of productive capacity and the greater call thus made on the nervous and mental energy of the workman, what is the workingman the better off for all the civilization? Finally, as regards the increased cost of living through a rise in the scale, may it not be the case that such a rise in the scale of living is to some extent what is meant by progress, though the drawback of the slavery of the workers, which some workingmen appear to feel so keenly, remains? How far is the "slavery" itself avoidable, so long as human nature is what it is, unless at the risk of all civilization perishing? Such problems are obviously of the deepest interest. The desire for leisure, for an ease to a severe strain, in all these complaints, is itself very striking, and may perhaps be held of itself to indicate a change of working-class conditions, as compared with a time when the masses simply endured, or were content to drag on a dull existence, with little color in it, and without hope of change. The whole subject, at any rate, should be well worth considering. What are the facts, and what should be the conclusions regarding them?

Dealing with the first head of complaint, which is perhaps the simplest and most easily dealt with, we must allow it to be obvious on the surface that there is a real point for discussion. Under the essential conditions of modern life, principally the concentration of huge masses on narrow room, competition among laborers undoubtedly produces monopoly rent, the payment of which is a simple deduction from the gross money wages which workmen receive. If workmen, to avoid paying more than they can help, live at a distance from their work, they only escape the evil partially, because charges for conveyance to and from their work have to be paid. Clearly workmen under such conditions, as compared with conditions under which no monopoly rent or its equivalent has to be paid, are at a disadvantage. To show their real position for the purpose of comparison, the monopoly portion of the rent must be deducted. It is quite obvious, also, on the merest superficial aspect of the question, that as regards many workmen, at least, the disadvantage may easily be so serious as to compensate, and more than compensate, all the difference between the money wage of the country, where there is no monopoly rent, and the money wage of the town. Take the case of a west Highland peasant fifty years ago, living on a scanty wage of a few shillings a week, or the produce of a poor croft eked out by kelp-gathering or fishing, and his descendant at the present time in the slums of a great city, earning perhaps fifteen shillings a week, but disbursing four or five shillings for rent. The improvement in money earnings may be immense, perhaps one hundred per cent, and as regards prices of commodities there may be no drawback in the change, but the rent takes a monstrous cantle out of the margin. Comparing all the conditions, it may certainly be doubted whether the peasant, in the case supposed, in exchanging the hard life of the country, which still had the advantage of being in the open, for the hard life of the city, has made any real advance. Take a case higher in the scale. A doctor, to earn a living, resides in a city rather than in the country, pays a huge monopoly rent to begin with, and incurs many other analogous expenses, so that altogether he has a large leeway to make up before he can reckon that net income which can properly enter into comparison with that of his country colleague. The difference may easily be so great, I believe, that in many cases a professional man in a small country town with three or four hundred pounds a year may have a larger net income for the real objects of life, dealing with the question in a wise, philosophic spirit, than a professional man in London with a thousand or twelve hundred pounds a year. There are differences even between London and smaller provincial cities. Thus the question between gross and net, which workingmen have raised in these discussions, apropos of monopoly rent or the equivalent, is a real question. It is a new form of the old theorem that people may buy gold too dear.

I have already, in part, dealt with the question practically as far as workingmen are concerned, by pointing out the really narrow limits of monopoly rent,* and practically the final conclusion must be reached by the statistical method, and in the way I have already used. But I wish to avoid statistics for the present, and to indicate merely the general conditions of the problem to be solved, which appear to minimize the possible extent of the alleged drawback.

It is clear, first of all, on general grounds, that the concentration of men in cities is due to the fact that cities, on the whole, weigh in the balance against the country. There is more and better employment there than in the country, all deductions made, in the opinion of those interested; and that seems a conclusive answer to the question as to whether, on the whole, there is not a net as well as a gross improvement in wages as far as this drawback is concerned.

Next, it is plain that, as a great part of the improvement of the last fifty years has consisted in the substitution of artisan and other highly paid labor for merely rude labor, the additional monopoly rent payable in the cities can only be, in most cases, a comparatively trifling drawback. It may be the case that, if we compare the former peasant of the country with the rude laborer of the city, and especially of the metropolis, the latter has hardly gained; but if we compare the former peasant of the country with the town artisan of the present time, although the latter has to pay monopoly rent or an equivalent charge for conveyance, there is still an enormous gain in the latter's position. It is the same with the professional classes. If the latter were stationary in number, or increasing only *pari passu* with the increase of population, then the larger gross income on the average earned by the masses of professional men in cities, as compared with the professional incomes earned in the country formerly, might show little *net* improvement; but allowance has to be made for the fact that the number of such incomes has enormously increased, and that the earners largely compare with the earners of wholly inferior incomes in former times, whether in town or country. As the increase of these classes could not have taken place without the growth of cities, there must be a large net as well as gross gain to be reckoned when the comparison is properly made.

To bring the matter to a point, what I have to urge is, that the very growth of cities implies the existence of conditions under which workmen of higher grades take the place of workmen of lower grades, so that, although class for class a workman passing from country to town does not seem to gain so very much, on account of the difference between gross and net, yet, man for man, on the average there is an enormous gain. Illusion is produced because the proper terms of the comparison are lost sight of. The point is especially important as regards what is known as the residuum. Nothing can appear so deplorable or so hopeless as the conditions of the floating mass of rude labor in large cities. Monopoly rents in this case appear to sweep away all possible advantage which may result from higher money wage, comparing the laborer of the town with the laborer of the country. In many cases, even, it must be admitted, the "residuary" of the city is on a lower level than the "residuary" of the country. His "net" earnings are less. But the question, after all, is one of proportion. The absolute magnitude of the city residuum must not blind us to the fact that it may be, not an increasing but a diminishing element with reference to the population generally. I believe it is a diminishing element, but this would hardly be the place to discuss the point, and I am content for the present to call attention to its importance in the discussion. The assumption, so often made, that the residuum is increasing relatively, is one which requires proof, and I have never seen any attempt at proof, while there are some broad facts, such as the diminution of serious crime and of pauperism, against it.

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* See "Essays in Finance," second series, pp. 381, 382.

The question of the way in which the net value of an increase of money wages may be affected by the necessity of living in a more exhausting, or in some way more expensive, climate, or by the specially exhausting character of a highly paid occupation, such as puddling, is one of the same kind. There is clearly a point in the matter for consideration and discussion. I am disposed to believe, for instance, that the exhausting climate of the United States, compelling the consumption of more food to enable the same work to be done, is a distinct drawback to the American workingman as compared with his competitor in western Europe, and especially in Great Britain. I am not sure but that living in the south of England, owing to climate, is more expensive than in the north and in Scotland. The point has hardly been expressly considered, the workingman practically having been right to go where he gets the highest money wage, but it is one that may become of increasing practical interest now that charges for conveyance are so low throughout the world as to make it quite unnecessary for men to live near the places where their food and raw materials are produced. I shall be well content for the present if the remarks here made induce some workingmen to elaborate it from their practical experiences. Of course, in any discussion it would also have to be considered that the greater expense of living may not be a pure drawback. The ability to consume and produce more, to bear exhausting climate or occupation, in fact, may be a good thing, and bring its own compensation, although the net gain, taking matters strictly, may hardly be appreciable.

The next head of complaint is the increase in the severity of labor and the want of any proportionate remuneration.

On this head it may be admitted, to begin with, that there is apparent foundation for some of the complaints. Workmen in particular employments do not get a reward at all in proportion to the increase of production in those employments. The illustration of a cotton-mill is familiar. A single attendant on a number of machines will "produce" as much in an hour as formerly in a year or two, but his wages are only double—or perhaps not quite double—what they were when the production was so much less. A great steamship supplies another illustration. The ship does many times the work which could have been performed by the sailing ship it has displaced, and with much fewer men in proportion to the tonnage conveyed. But the wages of the average member of the crew are again only double, or not quite double, what they were when the conveyance done was so much less. In these and similar cases, who gets the benefit of all the increase of production? The workmen in the particular employments concerned, receiving only a fraction of the gain, may be excused for suspecting that there is something inexplicable in those social and economic arrangements by which the benefit is spirited away from them.

But, however natural the question, it is not difficult to point out that there is a good reason why workmen in some given employments should only receive a fraction of the benefit from the increased productiveness of those employments, and that this fact is quite consistent with an improvement in the position of workmen all round in proportion to the generally increased productiveness of labor, which is the real question we are now investigating, for the purpose of comparing this increase of productiveness with the increase of the severity of labor throughout society. The short explanation is that the employments in which there is a great increase of production, being mainly the employments in which there are great mechanical improvements from time to time, constitute only a part of the whole employment for labor, and that by a natural law labor in each employment finds its level, the increase of the return arising from an invention in a particular employment resulting in a gain, not to the particular laborers concerned, but to the whole community of laborers. That the gain may be general, it is, in fact, essential that laborers generally should gain as consumers rather than as producers, which implies that in a given employment wages should increase, not in proportion to the increased productiveness of that employment by itself, but in proportion to the increased productiveness of labor generally. Hence, it may well be that while the productive power of machines may enormously increase, yet the general increase of productive power may be much less than would at first be thought, owing to the comparatively small proportion of laborers, after all, who use machinery of great capacity largely in their employments. Looking at the number of domestic servants, of clerks, of professional men and women, of unskilled laborers of every kind, of skilled laborers, such as painters, who do not use machines, I should doubt very much whether one fourth of the laborers, even in a society like that of England, the most manufacturing in the world, use machinery of great capacity in their employments. It is easily to be accounted for, therefore, why in a given employment there should be a great increase of production without a corresponding increase of remuneration to those engaged in that particular employment. The gain has to be diffused through society, and the increase of production generally is not so great, and not nearly so great, as in a few special cases.

Another observation must be made. There may be a considerable improvement in the quality of production in employments of a non-mechanical kind, which it is difficult or even impossible to note by quantities, but where the labor competes with all other labor for remuneration. Where the increased remuneration should go to, when machines improve, is not thus so easy to determine *a priori*.

It is also obvious that even in an advancing community the remuneration of certain kinds of laborers, whose numbers continue disproportionate, may either not increase at all, or increase very little, the whole gain from increased productiveness being for the benefit of the laborers whose own labor improves in quality, apart from the fact that it is employed on more productive machines. Strictly speaking, unless there is a rise in the scale of living, accompanied by an improvement in quality all round, there is no reason why, in modern times, a man who can only drive a spade into the ground, or wheel a barrow, or carry bricks up a ladder, should receive any higher reward than similar laborers in former ages. The fact that such laborers are little better off is not inconsistent with the fact that workmen generally receive a larger reward than in any former period.

The way is thus cleared for answering the question as to whether the remuneration of labor has increased generally in proportion to the increased severity of labor.

It can not be denied, first of all, that there is a great increase of the productiveness of labor itself, as well as a great increase of the absolute amount of remuneration. This is admitted on all sides. The increase of production is the very fact which is assumed. Nor is the increase of remuneration denied—the only question is of the proportionate remuneration. Before passing from this point, however, I should like to dwell a little on the fact already referred to, of an improvement in the quality of non-mechanical labor, because, as this labor is largely the subject of direct exchange without much intervention of capital, the mere fact of improvement implies almost a proportionate increase of remuneration. At any rate, the laborers concerned get almost the whole benefit, because they exchange with each other. I refer to such employments as those of teaching, medical attendance, nursing, domestic service, dressmaking, and the like among the upper and middle classes. The increase of remuneration here may not be in proportion to the improvement of quality; the game may not be worth the candle; but, at any rate, the exchanges are direct. Now, as to the fact of great improvement, I believe there is no doubt. Nursing, for instance, is said to be an entirely different thing in hospitals from what it was only fifteen or twenty years ago. Domestic service, as regards cooking, waiting, and other points, is also, on the whole, better, notwithstanding manifold complaints, just because of the general improvement in education and intelligence. The same with dressmaking. More intelligence and skill are everywhere applied, and in direct exchanges, without much intervention of machines or of capital.

Next, it has to be considered, as regards the question of proportionate remuneration, that by the very mode of here stating the question, it appears that it is not so much a question of increase in the severity of labor generally, as of a change in the character of the labor. If the quality of labor has altered and improved in many directions, there is, in truth, no proper term for comparison between the present and former times. The improvement of the quality of the labor, which is another name for the increased intelligence and energy of society, may not be proportionately remunerated; but there is no means of telling. People would not go back to the conditions of a former society, where less intelligence and energy were required for a lower scale of living, even if they had the choice. The new advantages, with all their drawbacks, are accepted as part of a higher state. The complaints are to some extent a sign of the perpetual unrest of human life, and of the fact of improvement itself.

There can equally be no doubt, looking at the matter in this way, that in certain directions there may be a very poignant and not unjustifiable feeling as to an increase in the severity of labor. This appears to be the case as regards employments which involve the watching of machines, the very employments where there is apparently the greatest increase of production and the least proportionate increase of the remuneration of labor. The strain upon the nervous system, through the combined monotony of the employment and the constant vigilance required, are no doubt very often most severe, and are perhaps felt the more because the present generation is comparatively untrained. But the increased severity of toil, without proportionate remuneration, might be admitted in those special employments without altering the fact that remuneration has increased generally. What seems to have happened in these cases is, that the development of society imposes a heavy burden on a special class, involving rapid change in the quality of its labor, to which it is hardly equal, but that the improvement in quality is part of the general improvement in society. The nervous power to stand monotony and supply the necessary vigilance and other moral qualities necessary for the supervision of machines may exist in greater abundance in the next generation, along with a continued improvement in the quality of labor in non-mechanical employments.

It will, perhaps, be urged that the workman does not get a proportionate remuneration because the capitalist obtains for himself the increased product—the socialist argument. But the facts are all against this explanation. One of the most remarkable facts of recent years is the general decline in the return to capital. Capitalists from year to year have been willing to invest for a smaller and smaller return. We must assume, then, that if they have gained at all it has only been by the immense cheapening of commodities, and labor has gained more than in proportion. This would appear to be the case: only the laborers who have gained, as we have seen, are not specially those who are occupied about machines. The gain is generally diffused, and is received by laborers generally in proportion to the relative values of their work. Apparently the greatest gain has been among the higher artisan and lower professional classes—the very classes, it may be remarked, by whom the strain of modern life is felt the most intensely.

The conclusion, then, is, that if the return to labor generally is not proportionate to the increase of the severity of toil itself, the reason must be that people are working for inadequate objects. The game, in one sense, may not be worth the candle. The problem is another form of the very same problem that has been considered with reference to the payment of monopoly rents. On the whole, notwithstanding all the drawbacks of city life, there is some improvement which makes the payment of monopoly rents worth while. People would not change back to the former conditions. So, on the whole, notwithstanding all the drawbacks of really severer toil, and the inadequacy of the additional remuneration, people would not change back. What has happened is really a revolution in the quality of labor and the general conditions of life. The net gain, in one view, is less than the apparent gross improvement, looking at the matter strictly; in another view, the gain is so great as to make the present condition of workmen on the average incommensurable with their former condition. The two things are not on the same plane, and can hardly be compared.

An important corollary seems to be suggested by these considerations. If there is so much doubt about the adequacy of the reward for the additional labor thrown on workmen by the conditions of modern society, is not that reward really a minimum reward? In other words, may not the amount of production itself be conditioned by the energy of the workman, which is in turn a function of the food and other things on which he expends his wages, so that the quality of labor by which modern society is carried on would not itself exist if the remuneration were less than it is? The complaint we are dealing with is that of the severity of modern toil, and implies that the workman is tasked to his full capacity, and can just do the work, so that the remuneration can not be reduced. And that this is really the case in many employments may be easily enough illustrated. It is quite certain that the driver of an express engine could not go through the very formidable labors he undergoes if he only had the food of the rude laborer of a former time, and only lived in the way that such a laborer used to live. He would not, under such conditions, have the energy or brain-power for the work to be done. It is the same with workmen in a factory who have to attend to many machines. The constant strain simply could not be endured if the workman had to live as the factory worker of a former time had to live. The present worker is really cheaper than the former worker, because he does more in proportion; but, dear as he is, yet, in another respect, he may perhaps be viewed, according to a suggestion already made, as really engaged at a minimum wage—without which he could not do the work at all. This is not a question merely of a rise in the scale of living, though that question is intermixed with it. It is a question of the actual necessity on the part of the workman that certain things should be put into him, or supplied to him, as a condition of his doing the work which he actually performs. What is true of the workman specially referred to is of course still more true of the higher kinds of work involving artistic or other skill.

It may also be added that the suggestion already made as to the reason for a non-increase of remuneration in certain directions being that the work done has not itself improved in quality, is fully confirmed by the general view thus stated. If the work which has improved in quality is itself only so remunerated as to make it doubtful whether the remuneration is adequate, whether the game is worth the candle, and is, in fact, at the point of minimum, so as to enable the work to be done at all, out of what fund is the remuneration of the work that has not improved in quality to come? In the midst of plenty, apparently, such workmen, by comparison, must starve, because, notwithstanding all the plenty, those who really do the hard work of modern society are only just paid, and no more. It is easy for such workmen and their so-called friends to point to the capitalists as living on *their* labor; and no doubt, if it were possible to divide the earnings of capitalists among society generally, according to numbers, these particular workmen might be much better off. But it is not from the labor of such workmen that capitalists mainly derive their income, while those who do work, as we have seen, have so large a remuneration that they can have no quarrel with the capitalist. The suggested division would therefore only be for the benefit of a special class whose existence is itself a danger to society, and which should rather be discouraged than encouraged, the whole efforts of society being rather directed to their transformation by education and similar agencies into a higher class, than to securing an increased payment for their work under present conditions. The curse of the very poor, in more senses than one, is their poverty—poverty in strength, in mental capacity, in moral qualities. They are poor because they can not earn more. If they were stronger they would have the earnings, and would have no quarrel with the capitalists. To improve their condition they must be made stronger, and not merely given more to spend, which would be a curse to them instead of a blessing, as it is to the merely idle capitalist whose luxury they envy, whose existence is a danger to society also, and whose obliteration, or rather transformation into a different class, is equally to be sought for.

The next head of complaint is that a workman has more expenses now, in consequence of the rise in the scale of living. Not only himself, but his family, must live better. They must have better and more food, be better clothed and sheltered, be better educated, and so on. The workman himself, on whom the burden falls, has no more surplus than before. He is not a freer man.

This head of complaint, however, demands very little remark. The statement of the complaint is, in truth, one of the best evidences of progress. Of course, there has been a rise in the scale of living. Such a rise was quite certain to come with an improvement in the earnings of workmen. The fact that it has come is itself one of the proofs of improvement. No doubt there is a continued absence of a free surplus. I suspect, however, that at no time have many people, in this country at least, had philosophy enough to be thrifty and careful, and to do without some things that appear to be necessary for their sphere in life, so as to have what is meant by a surplus. Its absence is certainly no proof that the condition of those who make the complaint has not improved. The scale of living has risen, and this rise, beyond all question, imposes a strain upon many workmen which only the greatest care and philosophy can mitigate. It involves of necessity severer toil on the part of the bread-winner, with no apparent surplus for himself.

It is apparent, however, that to some extent what is called a rise in the scale of living is, in reality, an improvement in the mode of living which is absolutely necessitated by the work itself, without which, in fact, the work could not be done. Where moral qualities are to be displayed, and great vigor, punctuality, and energy are required, they are not to be expected except from workmen of a certain class, whose scale of living has, in fact, risen to the standard necessary, and whose "medium" and "atmosphere," of which the condition of wife and children or relations is a part, are altogether different from what they were. Before human beings can display the qualities and exert the energies required, they must have certain tastes and wants to gratify, or there would be no motive to exhibit those qualities and energies. Hence a rise in the scale of living is only another mode of describing the improvement in the character of the workman, which is essential to the performance of the work to be done.

The conclusions of this long argument may now be very shortly restated. In certain cases the increase of net earnings by the advance of the last fifty years can not be so great as the increase of gross earnings, because some classes of workmen have to submit to an increased charge for rent and railway fares, and similar expenditure, which really amount to a reduction from the gross earnings which they receive. But, on the whole, the classes of workmen affected in this way must, from the nature of things, be comparatively small, while the general conditions are such that the deduction from gross earnings, as a rule, still leaves an enormous net gain. Next, the allegation as to the increased severity of labor, and as to workmen not getting a sufficiently adequate remuneration or a sufficient share of the increased gross produce, is met by the admission generally of an increase in the severity of labor, which, however, is found to be more properly described as a revolution in the quality of the labor, and to be connected with the fact of improvement generally, and to be evidence of improvement in the workman's condition. The character of labor generally has so changed that it can not really be measured in comparison with the labor of a former time. Some workmen engaged about machines may appear to get comparatively little of the increased production for themselves, but the reason is that the improvement in machines is for the benefit of society as a whole, and not specially for that of the particular workmen engaged upon them, who only participate in the improvement as consumers, and not as producers. Substantially, however, there is more severe toil all round, and whether the additional remuneration is adequate or not, the change in the quality of the labor is necessary to the production, the laborer gets all the possible remuneration, and the labor itself could not be carried on without the remuneration obtained. It is the same with the complaint as to the rise in the scale of living. The rise in the scale is at once a proof of the improvement in the workman's condition, and of the necessity for an improvement in his living to enable him to do the new work. The two things are inextricably connected. On the whole, the complaint of workmen as to the difference between gross and net is not unjustified, but it points to changes in their condition of a remarkable kind, which are in every way deserving of further study. To show fully what these changes are, statistics would be needed, but the necessary conditions of the problem are apparent without statistics. The complaints here dealt with could not exist without that improvement in society and the condition of the masses which the complaints seem to call in question.

A further conclusion may be drawn. The conditions of life thus indicated seem favorable, on the whole, to a continuous improvement in society, so long as science and art make progress, and heavier and heavier calls are made on the intelligence and energy of workmen, along with an increase of their capacities on the one side and their wants on the other. The whole structure of modern society is such as to require greater and greater knowledge, greater and greater energy and moral power, greater and greater capacity of every kind, so as to make sure that machines and inventions are maintained and improved, and that artistic capacities and the arts of living are developed to correspond. The continuous improvement implies a continuous improvement, on the average, of the human being who really belongs to the new society. So long as society, therefore, continues to progress—that is, for our present purpose, so long as the average workman continues to produce more quantity or better quality—there must be continuous improvement and progress in the quality of workmen themselves and the conditions of their existence, although we should not expect that complaints would cease as to the greater severity of toil and as to particular classes of workmen not getting for themselves the full benefit of the increased production. Still, the improvement is there, and the complaints, when analyzed, are, in truth, signs of the improvement.

The one doubtful sign, it appears to me, as regards the future, is pointed at by the qualification implied in the words—the human being *who really belongs to the new society.* It may possibly happen that there will be an increase, or at least non-diminution, of what may be called the social wreckage. A class may continue to exist and even increase in the midst of our civilization, possibly not a large class in proportion, but still a considerable class, who are out of the improvement altogether, who are capable of nothing but the rudest labor, and who have neither the moral nor the mental qualities fitted for the strain of the work of modern society. On the other side, as already hinted, the existence of what may be called a barbarian class among the capitalist classes, living in idle luxury and not bearing the burden of society in any way, seems also a danger. But speculations of this sort would perhaps take us too far at present. Substantially, as yet, there seems to be no reason to doubt the steadiness of the improvement in recent years among the working classes, both those practically so called and those who may be included when we use the language in its widest—that is, the strictly economic—sense, and that this improvement goes on from year to year, and from generation to generation, and must, in the nature of things, go on, in consequence of the improvements and inventions of the modern world and the general spread of education, so long as nothing happens to prevent a continuous improvement in the efficiency of human labor and the average return it can obtain from the forces with which it works.—*Contemporary Review.*

CONCERNING SHREWS.

By FREDERIK A. FERNALD.

THE shrews, or shrew mice, as they are often called from their mouse-like size and general appearance, are nearly related to the moles, but may be distinguished from them by their distinct outer ear and the moderate size of their fore-paws, which are not usually employed in digging. They have a long, pointed muzzle, with two very long cutting teeth in each jaw—the upper much curved and the lower nearly horizontal. Their other teeth are many-pointed, being thus adapted to seizing the worms and crushing the hard wing-cases of the beetles which form their food. They also sometimes destroy small vertebrates and devour each other. Most species of shrews live on the surface of the ground, and a few in burrows. They do not hibernate. They take their food at night. They are spread over the northern hemisphere, sometimes going very far north, and the smaller species enduring severe cold. The sub-family *Soricina* is the only one represented in North America; other sub-families are found in Europe, Asia, the East Indies, and in south and central Africa; none as yet have been detected in South America. Most of the American species belong to the genus *Sorex* (Linnæus). Prof. Spencer F. Baird described twelve species, varying in length from three to four and a half inches, in Vol. VIII of the Pacific Railroad Reports. In color they range from blackish and brownish to grayish above and lighter to whitish beneath. Most of the species belong on the Pacific coast or in the Northwestern States and Territories. The *S. personatus* is the least of the American shrews, and among the smallest of the quadrupeds of this country, being not quite three inches long; it belongs in the South Atlantic States. In the genus *Blarina* (Gray) the body is stout, the tail shorter than the head; the skull is short and broad, and the fore-paws are large in proportion to the hind-paws. This genus is peculiar to America. The mole shrew (*B. talpoides*, Gray), the largest of the American shrews, four and a half inches long, is found from Nova Scotia to Lake Superior, and southward to Georgia. It is dark, ashy gray above and paler below, with whitish feet. Several other species are described by Baird, of which two are in Mexico and Texas.

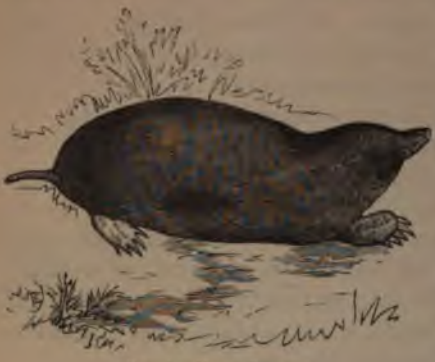

FIG. 1.—MOLE SHREW.

Four species of shrew are mentioned by Wood as inhabiting the British Isles: the erd shrew, the water shrew, the oared shrew, and the rustic shrew. The erd shrew, also called the shrew mouse, is the common shrew of England, and is found also all over Europe. Unlike most animals, they are often found dead; though, owing to their nocturnal habits, they are seldom seen alive. Aubyn Battye writes in "Longman's Magazine": "Every countryman is familiar with the sight of shrew mice lying dead on autumn footpaths and by sides of roads. The hot, dry English September weather presses very hardly on this class of animals. Worms retire then a long way below ground, and even the strong mole often can not follow them in the hard-baked ground, and has to trust to slugs for maintenance. The damp, dead leaves of the hedge-bottom, which were once the shrew's best hunting-ground, are dry and deserted now—a fatal change of things. Yes, dead we often see the shrew; and picking him up we hold it our hand a little creature of an oddly quaint and old-world appearance, with a coat like velvet, brownish black above and grayish white beneath. But the two ends of him strike us most; a long, pink-tipped snout, and a blunt, four-sided tail." Shrews are accustomed to eating much and often, which doubtless accounts for their dying so speedily when food becomes scarce. The reason why their bodies are seen lying about instead of being devoured by flesh-eating creatures is probably because they secrete a strong scent that does not seem to please the palate of cat or weasel. Cats will catch them to play with, and finally kill them, but will not eat them. Owls eat them, however, and so does the kestrel falcon. On account of this scent, the animal is known in some parts of England by the name of fetid shrew. In Scotland it is called the ranny. The Latin term *araneus*, or spider-like, has been applied to this creature by several writers, because it was said to bite poisonously like a spider. The body of the shrew is not much over two inches long, and its whole length from the snout to the tip of the tail is about four inches. It lives in little tunnels which it digs in the earth, and which serve also as a hunting-ground. The nest in which the young shrews are brought forth is not made in the burrow, but in some little hollow or a hole in a bank. It is composed of leaves and like substances and is entered by a hole at the side. The young are from five to seven in number, and are generally born in the spring.

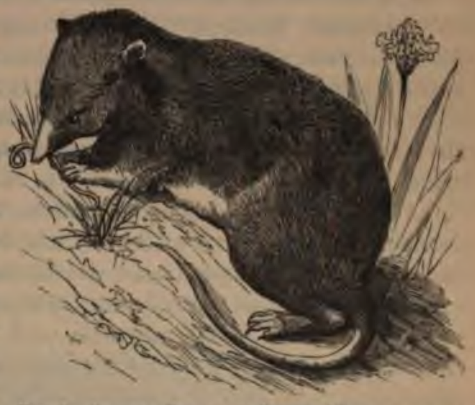

FIG. 2.—COMMON EUROPEAN SHREW (*Sorex araneus*).

The word shrew applied to a scolding woman has a different derivation, according to the dictionaries, from the name of our little insect-hunter. But it is no libel on the animal to give its name to a vixen even of a more unconquerable sort than is represented in Shakespeare's "Taming of the Shrew," as the following character which Wood gives it abundantly shows:

"Sometimes the shrews mutually kill each other, for they are most pugnacious little beings, and on small ground of quarrel enter into persevering and deadly combats; which, if they took place between larger animals, would be terrifically grand, but in such little creatures appear almost ludicrous. They hold with their rows of bristling teeth with the pertinacity of bull-dogs, and, heedless of everything but the paroxysm of their blind fury, roll over each other on the ground, locked in spiteful embrace and uttering a rapid succession of shrill cries, which pierce the ears like needles of sound. It is a most fortunate circumstance that the larger animals are not so vindictively pugnacious as the moles and the shrews; for it would be a very hard case if we were unable to put two horses or two cows in the same field without the certainty of immediate fight, and the probability that one of the combatants would lose its life in the struggle."

The bite of such a little creature obviously need not be feared by a human being, though ancient prejudice attributes to it such venomous properties that in many districts in England the viper is no more dreaded than the shrew. Even the touch of the animal's tiny foot was believed to cause pains which could only be relieved on the "like cures like" principle.

The following curious account of this latter superstition is from Gilbert White's "Natural History of Selborne": "At the fourth corner of the Plestor, or area, near the church, there stood about twenty years ago a very old, grotesque, hollow pollard ash, which for ages had been looked on with no small veneration as a shrew ash. Now a shrew ash is an ash whose twigs or branches, when gently applied to the limbs of cattle, will immediately relieve the pains which a beast suffers from the running of a shrew mouse over the part affected; for it is supposed that a shrew mouse is of so baneful and deleterious a nature that wherever it creeps over a beast, be it horse, cow, or sheep, the suffering animal is afflicted with cruel anguish, and threatened with the loss of the use of the limb. Against this accident, to which they were continually liable, our provident forefathers always kept a shrew ash at hand, which, when once medicated, would maintain its virtue forever. A shrew ash was made thus: Into the body of the tree a deep hole was bored with an auger, and a poor devoted shrew mouse was thrust in alive and plugged in, no doubt with several quaint incantations long since forgotten."

The shrew is often seen near reposing cattle, and this habit probably gave the chance for putting upon it any unexplained malady that the cattle might suffer. But it has been well suggested that the shrew goes to domestic animals for the insects which light upon them. From the fact that the shrew will eat one of its own species, if slain in battle, it is evident that insects and worms do not form its whole diet. "One of these little creatures," says Wood, "has been discovered and killed while grasping a frog by the hind-leg; and so firmly did it maintain its grasp, that even after its death the sharp teeth still clung to the limb of the frog. Whether the creature intended to eat the frog, or whether it was urged to this act by revenge or other motive, is uncertain."

The water shrew is much like the erd shrew in general appearance, but its fur is nearly black on the upper parts of the body, instead of the reddish-brown color which marks its relative. On the under parts its fur is beautifully white. The fur is very silky and has the useful property of repelling water. When swimming, the parts of the body which are submerged appear to be sprinkled with tiny silver beads, which give the animal a very brilliant appearance. This phenomenon is due to air-bubbles that cling to the fur. Water shrews are fond of pools and streams that are pretty well open to the sunlight.

The following account of them is given by the writer in "Longman's," already quoted: "See these water shrews, how they chase one another in the pool! Out of the water their fur is black and soft, but under it a thousand air-bubbles clothe them round till they flash like silver fishes in the sun. In and out of the weeds they swim, picking off the fresh-water shrimps from under the leaves. No sea otter is more at home under the water than they. Yet are their feet not webbed, but only fringed about with stiff white hairs. Instead of swimming with the direct motion of the water rat, the water shrew appears to move alternately both its feet on either side. Unlike the common shrew, which rears its young near the surface of the ground, often in the old nest of a field mouse, the water shrew nests in holes under the bank. It generally, I think always, appropriates some existing hole, which it no doubt improves to its liking."

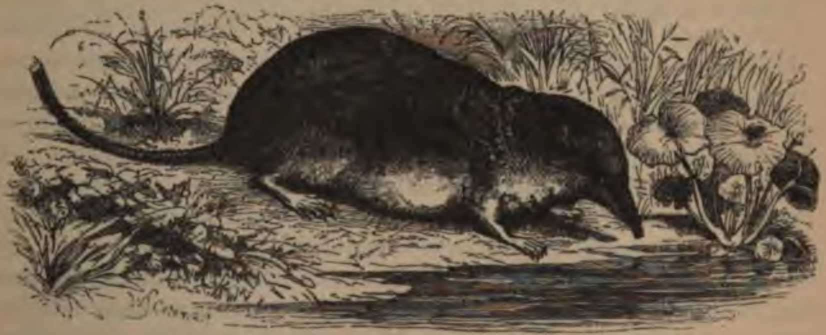

FIG. 3.—WATER SHREW (*Crossopus fodiens*).

Besides catching aquatic insects, the water shrew roots out larvæ from the muddy banks with its long snout, and does not hesitate to eat moths and other like insects which fall into the water and drown. The ears of this creature are peculiarly adapted to prevent the entrance of water. When it goes beneath the surface, the pressure of the water folds together three small valves, which effectually close the opening of the ear. "The total length of the water shrew is not quite four inches and a half, the length of the head and body being a little more than three inches, and that of the tail being about two inches. Its snout, although long, is not quite so narrow and pointed as that of the erd shrew, and its ears are remarkably small. When it swims, it has a curious habit of spreading out its sides, so as to flatten its body as it floats upon the water" (Wood).

Another kind of shrew which frequents the water is the oared shrew, so called from the oar-like shape of the feet and tail. It is the largest of the British shrews, its total length to the tip of the tail being about five inches and a quarter. The fur on its back is sprinkled with white hairs, and that on the flanks and belly is blackish gray, tinged with yellow. On account of the general dark appearance of its fur, it is sometimes called the "black water shrew." The rustic shrew (*Corsira rustica*) is found in many parts of England, while in Ireland it replaces the erd shrew.

The smallest mammal known to exist is found among the shrews. This is the Etruscan shrew, and it is found in Italy. Its head and body measure only an inch and a half in length, and its tail adds about an inch more.

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A CHEMICAL PROLOGUE.

By C. HANFORD HENDERSON,

PROFESSOR OF PHYSICS AND CHEMISTRY IN THE PHILADELPHIA MANUAL TRAINING SCHOOL.

THE human infant, during the first few weeks of its life, must be regarded simply as a bundle of possibilities. A bright light, a loud noise, an appreciable degree of heat or of cold, produce, it is true, corresponding reactions. The child blinks, or it starts, or it shrinks, and there is manifest to the most careless observer a general sense of uneasiness. But these reactions must be regarded as purely involuntary. One can not discover in any of them the presence of thought. There is no co-ordination of the faculties. The touch includes anything that may come within reach. It does not act in any way in harmony with the eye. Nor does the gaze become fixed upon any object. The eye wanders from one thing to another without really seeing anything. Similarly with the sense of hearing. Sound is a mere vibration, without any meaning whatever. If it be sufficiently loud, it makes the infant start much as a violent explosion would shake a window or rattle a pile of dishes.

But as the weeks roll by, there comes a marked change. When the child reaches the age of three months the presence of will becomes unmistakable. The faculties begin to act in harmony with each other; or, as we are apt to say, the child begins to take notice. Then it is that the birth of the human soul into the little body becomes apparent. The child is observed to fix its gaze upon objects. It begins to recognize faces; it begins to see; it begins to hear; it begins to feel. In a word, intelligence has dawned.

The years succeeding infancy are full of incident. Each day is crowded with new experiences and new sensations. Years pass before the most obvious of these are exhausted of their interest. The child reaches out its hand for the moon; it finds delight in the glancing sunbeam; it is surprised by its own reflection in the glass; it is charmed by all forms of rapid motion; it dances gleefully before the fire; it is made curious by the rustling of a leaf. The little man is full of the spirit of investigation. He is a true experimenter. He is constantly putting questions to Nature, and, after a fashion, he is finding answers. He awakens to consciousness in a world that is for him full of wonders and surprises. There is no truer fairy-land than that in which he daily moves. The ever-present mystery; the delightful sense of anticipation; the persistent belief in the impossible, make childhood—in spite of its little worries and absurd fears—a veritable paradise, from which advancing years, like the angel with the flaming sword, casts us out all too soon.

The activity of the child is exceedingly interesting in the abstract; perhaps a little inconvenient in the concrete. He throws a goblet on the floor, and is as much amazed that it should break as the owner of the goblet is annoyed. It is a destructive age, and is apt to meet with but little sympathy from older persons who forget that they have gained their own store of knowledge from just such a series of adventures. Children willingly sacrifice a toy to learn what it is made of, and I am disposed to think that the knowledge so gained is worth more than the plaything. And so the first years of life are spent in becoming acquainted with surrounding objects. The days are very full of pleasure when one is acquiring knowledge in this simple and natural fashion. All of us have gone through these experiences. By hundreds of tests—pleasant and otherwise—we have learned that certain substances are brittle or tough; are hard or soft; are rigid or flexible; are light or heavy. By repeated falls we have gained some notion of gravitation—that bodies unsupported will fall to the ground. Burned fingers have taught us that flame and fire are hot. Torn jackets have shown us that there is a point beyond which we can not go and expect cloth to resist strains. It is in this way that we have gained our stock of common knowledge. Experience *is* undoubtedly the best teacher. When maturity is reached, all have gained the greater part of this common stock, and the affairs of everyday life proceed upon the very reasonable supposition that such knowledge may be taken for granted. But the question arises as to whether experience shall be permitted to end here, and so superficial a knowledge content us. It has been good for man to learn these more common truths. Would it not, then, be well for him to carry the search somewhat further, and to learn facts less commonly observed, as well as to investigate as far as he is able the cause and significance of all phenomena? There is but one answer: it is overwhelmingly affirmative.

It is to this problem that science addresses itself. The value of a study so intimately connected with the conduct of life is attracting an increasing number of students. The old battle between science and the classics in college curriculum does not need to be waged over again. Generations devoted to the pursuit of language have at length evolved a people in whom facility of expression is hereditary. The lack of something to say alone prevents universal authorship. The youth of the present day ask a discipline more inspiring than that offered by grammar and lexicon. It is found that the mind can be both instructed and trained without first killing the natural curiosity and interest of the pupil. It is true that there is a college near Philadelphia where a young woman is not even permitted to take a special course in biology unless she has an intimate knowledge of at least three foreign tongues, but happily such absurdities are rare. As a rule, the colleges and universities of the country have responded generously to the demand for broad scientific culture. In that field the battle has been won. But a little leaven leaveneth the whole. Beginning at the top of our educational system, the tendency toward scientific study is gradually making its way down to the very Kindergarten. It would be still more general, and would be a larger factor in individual life, were that important truth realized which Mr. Herbert Spencer has so often insisted upon, that scientific knowledge is simply a higher development of common knowledge, and means only more accurate and more extended thinking about our environment. And so, in science, we are to become again as little children, and put more questions to our great mother, Nature.

The results of this renewed questioning will not be trivial. They serve a dual purpose. They bring a much enlarged experience, and discover to us the relation between widely different phenomena. By the one service, the confines of our apprehended universe are expanded to such magnitudes that they demand for their occupancy the highest intellectual effort of which man is capable. Through the other, no confusion results from this immensity. It is a world of harmonies and relations. Man feels himself not oppressed, but inspired, by such a contemplation of

Infinity. He is one both with that star-beam which left its home before America was discovered, and with the blowing flower which a breath of summer has called forth. It is no mean vantage-ground, nor one which the spectacled haunter of libraries can afford to despise, to feel one's self a sharer in the pulsating life of the universe, to be a citizen of space, at home everywhere. Such is the position of the earnest scientist. He is the true poet and the true prophet. He lives in communion with a God who is the same yesterday, to-day, and forever; in whom there is no variableness, neither shadow of turning. This absolute confidence in the inexorableness of divine law begets a serenity of life which is with difficulty disturbed, and a deep morality of thought and deed which is seldom the child of more local revelation. The idea of chance or caprice becomes impossible.

> "All's love, but all's law."

It is with a curious pity that the student of Nature watches the crowd of worshipers at the Tower of Babel. He is willing to admit, with Max Müller, that there is no thought without language, and no language without thought; but so pre-eminent seems the thought to him that he feels well assured that a suitable vehicle will not be wanting for the carriage of so royal a guest. To such a one, the conduct of life becomes the chief end of education. The crucial test which he applies to each branch of study offered to either young or old is not whether it is useful, but whether it is the *most* useful. He will not be satisfied with any choice that is merely second best, for time meanwhile is flying, and, if we do *this*, we can not do *that*. The question is not whether any particular course will bring wealth of information, but rather whether it will induce fullness of living. It is surprising with what a small stock of facts, if they be of the right sort, a man can get along, and still be happy and progressive. I remember, as a boy, the envious regard which I bestowed upon a little friend of mine, whose dexterity in the difficult art of parsing quite surpassed my own feebler efforts. But one day I made the discovery that not only was he no better for entertaining that sort of knowledge, but, what was more surprising, his English was no more polished than my own. Since that time I have had frequent occasion to recall the discovery, and I confess that it has reconciled me to an ignorance upon many similar subjects. The substitution of this artificial, lifeless knowledge for that which is natural and organic, must be regarded as scarcely less than criminal by those who hold the true aim of culture to be the evolution of wisdom and of goodness. A man can not be expected to think soundly about a world of which he is quite ignorant, or to bring himself [illegible] with a universe whose confines are nearer th [illegible]

It is true that scientific education may fail quite as dismally as the classical has in times past if the grand generalizations of science are to be obscured by its manifold details. Emerson has somewhere said, "Men are so prone to mistake the means for the end that even natural history has its pedants who mistake classification for science." As a detached fact, the knowledge that water is composed of hydrogen and oxygen has no value. It is only when brought into relation with other chemical facts that it becomes significant. The statement found in elementary physical geographies and geologies that nine hundred and seventy-seven thousandths of the earth's crust consist of the nine elements—oxygen, silicon, aluminium, calcium, magnesium, sodium, potassium, iron, and carbon—carries very little instruction with it unless the children know the substances of which these names are the symbols. Mere classification is a weariness of the flesh. Science has no greater lesson to teach than roots and case endings have, unless it be linked to human life. Nor must it be pursued externally; it must touch our own experience, and its truths become a part of us, to be remembered because they can not be forgotten. This is knowledge, and nothing less than this deserves the name.

It is not so difficult to make even the more profound scientific studies touch intimately our daily life as one would imagine who has been taught to mistake classification for science. It is true that the multitude of objects which come within the field of scientific research require for their distinction a nomenclature which is not brief, but the student needs only a small part of it in the beginning. His vocabulary will grow with the using. In his "American Addresses" Prof. Huxley says, "For the purpose of getting a definite knowledge of what constitutes the leading modifications of animal and plant life, it is not needful to examine more than a comparatively small number of animals and plants." This, indeed, is the distinctive method of science. The student is made to advance from the particular to the general. The result justifies the method. By knowing a few things well, one knows everything, for one can not know even a few things well without having discovered by that very study the essential unity underlying all things. Our great geologists are not those who have "done" the earth, but rather those who have patiently and persistently studied a very small corner of it. To this rational mode of study all sciences are unmistakably coming. From its very nature, chemistry has been among the last to fall into line. It has been held, and in most quarters is still held, that the number of substances studied by the chemist should be limited only by the span of life. In accordance with this view, the young student, instead of being allowed to make friends with a few of the elements and really inquire into their secrets, has been hurriedly introduced to all of those available, and has been left to struggle as best he could with their multitudinous compounds. The result has been to confuse, and in many cases finally to disgust. Chemistry—and I do not wonder at it—has been voted "dry" by the majority of college boys.

This result has come about because the science has been unscientific. The meaning of science is *to know*, but one knows very little from such a gallop among the varied forms of matter. If one knows thoroughly two or three typical gases, two or three typical liquids, and two or three typical solids, he knows chemistry. He may not be worth much as a reference-book; but then encyclopædias are nearly always available, while thoughtful men are rare. Further, the quality of such knowledge deserves attention. It has become a part of the man himself, for he has learned it the way children learn things. It is no longer simply a fact of chemistry; it is a fact of life, a part of the oft-repeated experiences which go to make up his intelligence. Imagine for a moment the amusement of a bright boy were he asked whether he *remembered* if stones are hard, or lead heavy, or glass brittle. His answer will be that of course he does not; he *knows* that they are. It is knowledge of a similar definiteness that the scientific method strives to cultivate. Studied in this way, chemistry ceases to be a matter of simple memory, and becomes almost exclusively a branch of pure reasoning. It passes from the objective to the subjective world, and becomes a valuable means of mental development as well as a study now well worth pursuing for its own sake.

One of the first requisites, then, in the proper presentation of chemistry seems to be the entire banishment of that alien element which makes it a thing by itself, and the insistence upon its recognition as a purely natural extension of common knowledge. Any experience in life will form a suitable starting-point. It may readily be analyzed into its components; the chemical element can not well be missed. If the occurrence be such as we commonly call accidental, or, more strictly speaking, if it be devoid of human agency, it will resolve itself into two terms, conveniently expressible by the words matter and motion. If the occurrence be voluntarily producible, a third element is involved—that of will. It would be foreign to the present purpose to enter the vexed discussion of whether this third element, this unknown something which makes the distinction between conscious and unconscious existence, is the cause or the result of those reactions in matter and force with which will, as we know it, seems to be in [illegible] onnected. It will be sufficient for the present to call [illegible] involving neither issues nor compromises.

Any common event, then, which may be selected by way of illustration, will furnish two elements open to scientific study—matter and motion. The distinction between the two is more convenient than essential, for we are unacquainted with matter devoid of motion, and the idea of motion divorced from matter is similarly unthinkable. However, the distinction is convenient, so that it will be well to follow it. The study of the analysis and synthesis of matter is the field of chemistry. The study of those varied motions which give to matter its apparent properties belongs to the domain of physics. The two sciences are commonly made the objects of separate study. It would be more true to nature to consider chemistry simply as a branch or subdivision of physics, for it is impossible to make any change in the constitution of matter without at the same time disturbing the physical equilibrium. Heat is either given out during the reaction or it is taken in. If it be chemical combination, heat is commonly disengaged; if a chemical disunion, heat is commonly involved. So general is the truth of this statement that we are able to predict what will occur chemically if the physical conditions are known. If there be two or more reactions possible, that one will take place which will liberate the greatest amount of heat. It is, indeed, the distinctive character of the so-called New Chemistry that it takes cognizance of the physical reaction which invariably accompanies the chemical. If the labors of Crookes, Roscoe, Hunt, and other eminent contemporary chemists count for anything, it is from such joint study as this that the best secrets of chemistry are to be evolved. With the view of lessening difficulties, this necessary interdependence between the chemical and physical is frequently omitted in presenting the science to young students; but the practice of teaching errors or half-truths, in order that the truth itself may afterward be apprehended, has as little excuse in science as it has in religion, for generally it is the error which proves obdurate, and the subsequent truth has no chance whatever. It robs the science, moreover, of an element of vitality which is one of its chief attractions.

In selecting our illustrations of chemical action, the more commonplace the event the better. The affairs of every-day life present such excellent objects for study that it would be as unnecessary as it would be uselessly distracting to go in search of the unusual, until the fundamental principles have been learned from a study of that which is familiar. That coal will burn, that milk will sour, that iron will rust, that cider will turn into vinegar, and that wood will decay, are all well-known facts of every-day life. But they are also facts of chemistry, for they involve a change in the composition of matter. It needs no scientist to perceive that the original coal, milk, iron, cider, and wood have disappeared as such, and that new substances with totally different properties have taken their place. Yet this is all that a chemical reaction means. It may be studied any day in the kitchen. The question of heat is quite as obvious. The coal has been burned for that very purpose. At first sight these several facts seem entirely unrelated. They have been selected quite at random. A moment's consideration, however, will show that these reactions, though seemingly dissimilar, are essentially identical. Your cook may not be able to explain them to you, but she can tell how they may be prevented, and that will serve the purpose equally well. Her answer will be the same for all: Keep the air from them. A fire with all the draught closed off goes out. Hermetically sealed milk keeps fresh. Painted iron does not rust. Bottled cider remains cider. Wood, not exposed to the air, will endure for centuries. So, after all, the common element in these reactions is not difficult to find. It is manifestly the air, for, in the absence of that, they do not occur. To the chemist they are all cases of oxidation. If he wishes to prevent them, he does just what the cook does—he keeps the oxygen of the air away from them. That is all that Mr. Edison does when he pumps the air out of the bulb of his incandescent electric light, so that the little carbon horseshoe shall not burn up.

Now, there is nothing occult about all this. The examples given are not sufficient in number to warrant any very broad generalization, but they can readily be extended, and conclusions of universal application reached without other resource than that found within one's self. Beginning in the home, one's conclusions will be found to extend to the town, to the county, to the State, to the world. One may finally think about the universe. The spirit in which these investigations are conducted will be that of an inquiring child. It is literally true in science that "a little child shall lead them." The men who have built it up have labored successfully in exact proportion as they have put their questions directly to Nature rather than to books and to the sages. The most hopeful sign that the growing scientific mind can disclose to its fellows is that increasing simplicity of heart and mind which has characterized all the immortals recognized by science. It is this very faculty that has made men of science so notoriously incompetent in business matters. We have come to expect little news from a sharp bargainer.

Questioning Nature in this childlike and natural fashion, life becomes again a daily revelation, and inspiration a contemporary event. It is paradise regained. There are still suffering and sorrow, but there are also their antidotes, hope and faith. There is universal law, but there is also universal love. The severe harmonies of the universe lend grandeur and dignity to the passing moment. One feels that the destiny of man is assuredly noble.

The student will not go far in his quest before facts begin to accumulate which are fraught with the deepest significance. He has known perfectly well all along that only a certain amount of heat can be obtained from burning a definite quantity of coal, and that it will be given out in proportion to the rapidity with which the burning is accomplished. If he wishes his room to be warmer, he opens the draught and gives a more abundant supply of air to the fire. The operation has been too often repeated to excite any wonder. But it becomes significant when he discovers that all other chemical reactions rest upon precisely the same principle. Each substance is found to have a definite combining power, and in every reaction, however simple or complex it may be, a definite quantity of one element unites with a definite quantity of another. If too much of either element be taken, it will be left over. But this is the law of definite proportions discovered by Dr. Dalton in the early part of the century and now the very corner-stone of chemical science. If the student further inquire what has become of the coal and the oxygen whose union we call combustion, he will find that a colorless gas, carbonic-acid gas, has been formed whose weight is exactly equal to the sum of their weights. Other illustrations will yield parallel results, and the far-reaching conclusion will be forced upon him that man is neither able to create matter nor to destroy it. This single truth once really apprehended gives a stability to thought which can scarcely come from any other single consideration. The universe is seen to be in an eternal ebb and flow, but its materials are seen to be constant. Once persuaded of the fact, and the suspicion arises that the same may be the case with heat and other forms of motion. And such he finds to be the truth. He learns that energy likewise is neither creatable nor destructible, and that all the work going on in the universe is simply that of transformation. New distributions of motion and new combinations in matter, these make up the cosmic life, but the sum total in each case remains unaltered. Perpetual motion is seen to be more than a possibility; it is found to be a necessity. One sees all of the universe in a state of ceaseless flux, sees that nothing stands still, that growth involves never-ending change, and becomes prepared to accept without fear those changes of opinion which intellectual growth necessitates as well as that great change of state which we call death. I can not hold as idle or of secondary import the speculations which these considerations engender. It is good for a man to penetrate as far as he may into the established order of the universe, for its secret is his secret, its process is his process. Curious thoughts spring from brooding over these doctrines of the conservation of force and matter. If in imagination we go back to that early time when our little planet was thrown off from its parent sun, we see, in the nebulous stuff from which it has precipitated, the materials of our own bodies. We are conscious of having had part in that wonderful birth, of having been present at the creation of the earth. It is true that we were very absent-minded at the time, but nevertheless our interest in that little ball of glowing vapor sent whirling off into space was even then a very personal one, for it was the aërial ship that carried our own destinies. If, then, the smallest atom that to-day forms a part of the delicate organism which we hold to be the tool of an indwelling spirit, has existed from all time, and is pledged to all eternity, it is difficult for the student of nature to conceive that the intellect which has given worth and dignity to this otherwise inanimate mass of matter should not be equally enduring. He is led to believe in an immortality of spirit which has known no beginning and will know no end. He is brought to what may be called the doctrine of the conservation of soul.

It has been a dream of poets and philosophers that there is in all the universe but one true element, and that the so-called elements—what we know as gold and silver, copper and iron, hydrogen and oxygen—are but modifications of this one primordial unit. The chemists of the nineteenth century are turning poets and dreaming this dream over again. What would have been scorned but a few years ago as alchemists' madness is now orthodox science. It is hard to believe that such a heavy, infusible metal as platinum has anything in common with a light, combustible gas like hydrogen; but, when we come to think about it, it is still harder to believe that the two are unrelated. When it is found that such dissimilar substances as charcoal, graphite, and diamond are chemically identical, it is quite possible to believe that all the elements are the products of a chemical evolution that has perhaps started with the element "helium," which the spectroscope discloses in the atmosphere of the sun. Thus the belief in the essential unity of the universe grows apace, and the cosmic drama gains in wonder as it gains in simplicity. What Goethe has called "the open secret of the universe" stares every man in the face. As one follows the wonderful story of its mode of becoming, and traces the far-reaching harmonies and relations, he is moved to exclaim with the devout Kepler, "O God, I think over again thy thoughts after thee!"

These considerations by the way, have for their sole purpose the indication of what I feel to be the rational mode of approach to the study of chemistry. It is a science so competent to become a means of keen intellectual pleasure and a stimulus to the most profound thinking, that its neglect by all but special students seems to me the neglect of a source of inspiration that one can ill afford to slight. Pursued in the spirit that I have tried to indicate, as a natural extension of the experimental knowledge of childhood, and through the medium of a few substances thoroughly studied, I venture to recommend it quite as highly as a means of culture, as an end valuable in itself. It would be an easy task to extend such considerations indefinitely; but I want rather to open the right door into chemistry, than to decorate its vestibule. "It is a foolish thing," says the author of the Book of Maccabees, "to make a long prologue and to be short in the story itself."

THE PHYSIOGNOMY OF THE MOUTH.

By TH. PIDERIT.

THE muscles of the mouth have a triple function. They serve in the articulation of sounds, and assist the activity of the taste and the hearing. Our present study is limited to the movements of the buccal muscles, which have to do with the taste. Taste is the earliest developed of all our senses, and abides with us from the first to the last hour of life. No other sense controls man so early or with so much power; none remains so long faithful to him.

The lips may be regarded as a flat, circular muscle placed in front of the buccal cavity, cleft horizontally in the middle, with a moist, ruddy mucous membrane covering the edges of the opening thus formed. Not regarding now the muscles of the lower jaw, the mouth is closed by the contraction of the orbicular muscle of the lips, and opened by antagonistic muscles which are fixed on its outer edge. The mouth is, then, destined to undergo very great variations of form; and, by virtue of this variety of its movements, it enjoys at least as much importance as the eyes in whatever concerns the mimetic expression of the countenance.

When any object perceptible to the taste is placed upon the tongue at rest, the sensation of the contact is vague and imperfect. It is only when the upper face of the tongue is pressed against the osseous vault of the palate that a complete impression of the object can be made upon the nerves of taste, the extremities of which abut upon the caliciform papillæ of this surface. Hence, when in mastication we inopportunely encounter anything of disagreeable taste, we at once separate our jaws to get the tongue as far as possible from the palate or to prevent any further rubbing of the upper face of the tongue and repetition of the bad taste. The movement of the jaws is accompanied by a corresponding movement of the mouth. The upper lip is removed from the lower lip as the palate is removed from the tongue by the levator muscles of the lip and of the wings of the nose drawing it up. Each of these two muscles rises near the inner corner of the eye, and ends in two points—one of which is attached to the wing of the nose, and the other to the middle lateral half of the upper lip. When these muscles come into play, the expression of the face is modified in a striking manner. The red edge of the upper lip is drawn up in the middle of its upper half, and this part of the lip is turned over, so as to give the line of its profile a broken appearance. The wings of the nose are raised, and the naso-lateral grooves, which, beginning at these wings, continue in an oblique direction to the commissure of the lips, appear near their beginning strongly pronounced and unusually straight. A still further effect of the movement is an even folding of the skin of the back of the nose (Fig. 1). The expression thus depicted, appearing primarily with bitter tastes, is also associated with other disagreeable feelings, which have become characterized by the term *bitter*.

While in ordinary disagreeable representations and dispositions the skin of the forehead alone is wrinkled vertically, the bitter trait of the mouth also appears in such as are very disagreeable (Fig. 2). The significance and importance of this expression vary essentially according to the nature of the look. If it is dull, the face bears the impress of bitter suffering, and it is a sign that the person is suffering from bitter feelings and trials; but if it is firm and energetic, the face then wears the marks of lively reaction and violent irritation. When the eyes are directed upward in ecstasy, the vertical wrinkles are of course absent, and then, while the upper lip is contracting bitterly, the face expresses a painful concentration. Such is the expression which painters [illegible] d have sought to represent in the penitent

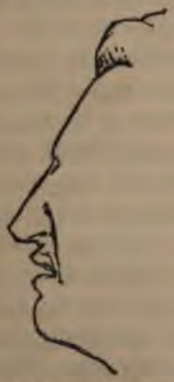

FIG. 1.—BITTER EXPRESSION.

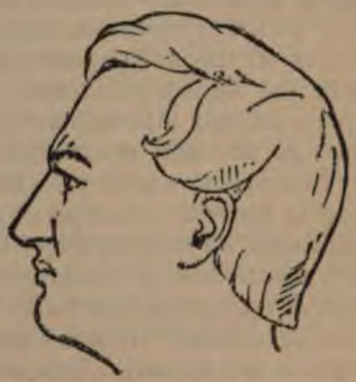

FIG. 2.—BITTER EXPRESSION, WITH VERTICAL WRINKLES ON THE FOREHEAD.

Magdalen. If, instead of vertical wrinkles, horizontal furrows appear on the forehead while the mouth is wearing the bitter trait, we recognize that the man is occupied with painful recollections.

The physiognomy is most violently changed when the expression of fear is manifested simultaneously with the bitter trait, or when the vertical and horizontal wrinkles both appear on the forehead at once. In this way the countenance receives the expression of violent terror. Leonardo da Vinci describes this expression in very striking terms when he says: "Paint wounded and bruised persons with pale faces and elevated eyebrows; the whole, including the flesh above, covered with wrinkles, the outside of the nostrils with a few wrinkles ending near the eye. The wrinkled nostrils should raise themselves and the upper lip with them, so as to expose the upper teeth, and these, parting from the lower jaw, will indicate the cries of the wounded." Darwin describes other symptoms of terror and fear as follows: "The heart beats quickly and violently, so that it palpitates or knocks against the ribs. . . . The skin becomes instantly pale, as during incipient faintness. This paleness of the surface, however, is probably in large part or exclusively due to the vaso-motor center being affected in such a manner as to cause the contraction of the small arteries of the skin. That the skin is much affected under the sense of great fear we see in the marvelous and inexplicable manner in which perspiration immediately exudes from it. This exudation is all the more remarkable as the surface is then cold, and hence the term a cold sweat, whereas the sudorific glands are properly excited into action when the surface is heated. The hairs also on the skin stand erect, and the superficial muscles shiver. In connection with the disturbed action of the heart, the breathing is hurried. . . . One of the best-marked symptoms is the trembling of all the muscles of the body. . . . From this cause, and from the dryness of the mouth, the voice becomes husky or indistinct, or may altogether fail. 'Obstupui steteruntque comæ, et vox faucibus hæsit'" (I was amazed, my hair stood up, and my voice stuck in my throat). This form of mouth occurs physiognomically among persons of a soured nature.

The sweet trait is opposed to the expression of bitterness; for while that seeks to avoid as much as possible a disagreeable sensation of taste, in it the muscles are set to play in such a manner as to gather up the gustatory impressions as completely as possible. The mouth is closed and the cheeks are strongly pressed against the teeth, so as to concentrate and retain upon the tongue all the parts of the sapid object, which during mastication and degustation glide between the cheeks and the jaws. In this way the activity of the nerves of taste is greatly assisted. The cheeks are pressed against the teeth chiefly by the action of the same muscles as are exercised in laughing, and for this reason the sweet trait bears a degree of resemblance with the trait of the smile; but the simultaneous contraction of the orbicular muscle of the lips suppresses to a considerable extent the lateral effect of the laughing muscles. The most essential characteristic, however, of the sweet trait is the peculiar form assumed by the lips; their orbicular muscle being drawn closely against the teeth, the red lips lose their normal swell, so as to appear flattened and straight when viewed in profile (Fig. 3). The mouth is drawn up in this way under the influence of unusually agreeable, sweet tastes, and also as a mimic expression of extremely pleasant feelings in the representations and recollections to which the usages of language have given the epithet of sweet.

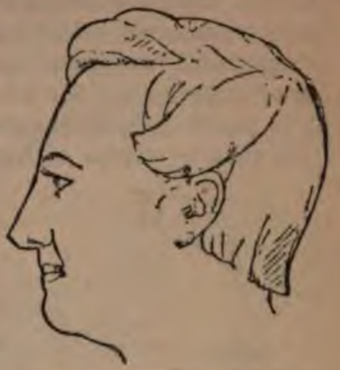

FIG. 3.—SWEET EXPRESSION.

The sweet mouth, combined with an enraptured look, gives the mimic expression of a pleasant reverie; joined with a sly look, the expression of amorous coquetry; with horizontal wrinkles it suggests occupation with pleasant thoughts or recollections. It frequently appears when the lips are prepared to give a real or feigned kiss. Inasmuch as the very agreeable feelings to which the term sweet is applied are of only exceptional occurrence, this trait is rarely developed physiognomically. It hardly ever exists among men, but is occasionally found among extremely affectionate women. When it becomes constant upon the face, it produces an impression akin to that of a too constant sweet taste, as if there were too much of it. If we observe the trait plainly impressed upon a person, we shall be likely to find him in conversation making much use of the word sweet, and speaking of "sweet women," "sweet music," "sweet love," and even of "sweet grief."

The central fibers of the orbicular muscle are capable of contraction independently of the lateral fibers, and this movement gives the scrutinizing trait. When we are on the point of tasting a sapid substance, such as wine, we introduce it between the lips projected into the form of a muzzle; we then carefully let the liquid flow slowly upon the upper surface of the tongue, in order that the impression of the taste may be prolonged as much as possible, and we may gain more time to appreciate it. The same expression may be observed on the faces of men who are examining the value of an object, whether it be something perceptible to the senses, or abstract thoughts or associations. The art critic looking at a picture, the doctor feeling the pulse of his patient, the judge weighing the testimony of a witness, the merchant deliberating concerning the acceptability of a commercial proposition—all are tempted involuntarily to project their lips, as if about to taste something sweet, and that the more readily as they fancy themselves better qualified to form a judgment. This trait furthermore betrays a kind of feeling of one's own value, a feeling of superiority; for whoever considers himself authorized and fit to pass a definite judgment on men, things, or events at once feels that by virtue of his quality of judge he rises superior to the object on which he is called to pronounce. For this reason the scrutinizing trait is also often the expression of arrogance and presumption (Fig. 4). If the scrutinizing trait is associated with vertical wrinkles, it indicates that, while the man is weighing and studying the reasons for and against the judgment he is to pronounce, whatever may be his final decision, he is already in a bad humor (Fig. 5). With horizontal wrinkles, the scrutinizing trait indicates that attention is fixed in the highest degree upon the matters that are under examination, and that they are considered very important or very delicate. A fine representation of this expression is given in Hasenklever's picture, "La Dégustation du Vin" ("The Wine-tasting," Fig. 7). This expression is frequently found among men who think much of the pleasures of the table. Their imagination indulging in fancies of pleasures obtained or anticipated, their lips advance as if they were really tasting what they are imagining; and thus the scrutinizing trait becomes physiognomic. It is also developed in men who have a high idea of their own value, and feel called upon to *judge* concerning the value of other men.

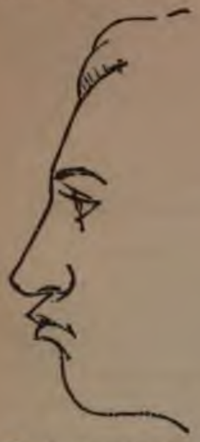

FIG. 4.—SCRUTINIZING EXPRESSION.

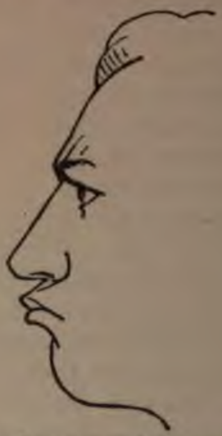

FIG. 5.—SCRUTINIZING EXPRESSION, WITH VERTICAL WRINKLES.

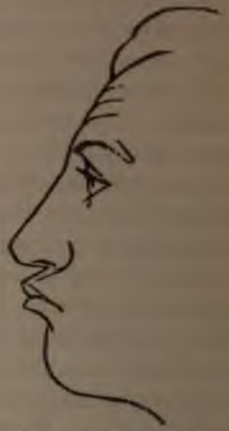

FIG. 6.—SCRUTINIZING EXPRESSION, WITH HORIZONTAL WRINKLES.

When we make any very violent bodily effort, as to put on a tight boot, or to open a tightly closed door, besides contracting the muscles of the arm, we stiffen the neck, clinch the teeth, and press the lips close upon one another. It is very evident that these muscles do not in any way contribute to the attainment of the end proposed; but at the moment when the man is calling upon all his strength and energy to overcome a difficulty by means of a bodily effort, the intensity of his will is manifested not only in the muscles that serve to produce the desired effect, but also in all the muscular apparatus of the body. Every muscle contracts; and, of course, the contraction of the weaker muscles is neutralized by that of the smaller ones. These simultaneous movements, without intention or object, appear more evidently in the facial muscles, and notably in the vigorous muscles of mastication. In all violent or difficult movements we are accustomed, by the contraction of the muscles, to press the lower jaw against the upper, as if we were tearing or breaking some hard object.

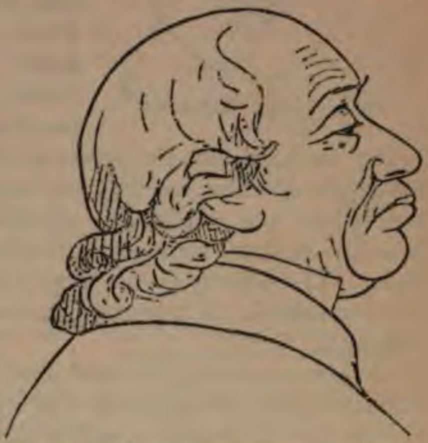

FIG. 7.—HEAD FROM HASENKLEVER'S "WINE-TASTING," SCRUTINIZING EXPRESSION.

The fact that we have noticed in connection with the bitter trait—that the movement of the lower jaw is accompanied with a similar movement of the mouth—is likewise observed in the pinched trait. As in the former case we remove, as far as possible, not only the upper maxillary from the lower maxillary, but also the upper lip from the lower; so, in the latter, we press the lower maxillary against the upper, and the lower lip against the upper. In consequence of the contraction of the orbicular labial muscle and of the incisor muscles, the lips are closely shut and their red edges are turned within; but at the same time the lower lip is energetically pressed against the upper, by the action of the two levators of the chin. These muscles start from the upper edge of the lower jaw, near the median incisives, directing their fibers downward and outward, and lose themselves in the skin of the chin. They lift the middle of the lower half of the orbicular labial muscle, and press the skin of the chin closely against the bone. In consequence of this movement, the middle of the lower lip seems to be raised, and simultaneously two wrinkles or inden- ar, which, beginning at the middle of the lower lip, are directed thence toward the sides, like the sides of an obtuse-angled triangle, in a straight line downward and outward. These two indentations are very characteristic of the pinched trait, and correspond with the lower border of the tense labial orbicular, drawn up in its middle (Fig. 8). This expression is, however, provoked not only by very intense corporeal but also by very intense intellectual efforts. The efforts, however, which we make in mental works—in scientific researches, for example—are rarely passionate enough in their nature to bring on a spasmodic pressure of the lips and teeth; but this takes place when we dispose ourselves for an intellectual combat, when one appeals to all the force of his will to defend himself against strange influences and guard his own convictions. The mouth closed firmly, with the lower lip raised, gives the expression of tenacity, stubbornness, obstinacy, and perseverance.

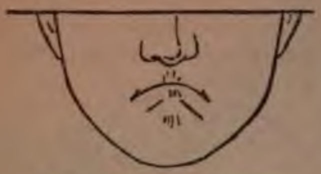

Fig. 8.—Pinched Expression.

A person having his teeth and lips closely shut and the skin of his forehead contracted at the same time into vertical wrinkles, shows that he is angry, and firmly disposed to contend about the matter that is on his mind (Fig. 9). If his lips are pinched and his eyebrows lifted up, he is trying to maintain the impressions that have determined him to an obstinate persistence in his opinions and intentions (Fig. 10). In J. Schrader's picture, "Gregory VII in Exile at Salerno" (Fig. 11), the tenacity of the mouth, the anger expressed in the vertical wrinkles, and the tense attention in the horizontal ones, joined with a secretive look, give to the face of the character the expression of a dangerous man who is contemplating perfidy and vengeance. Another combination is

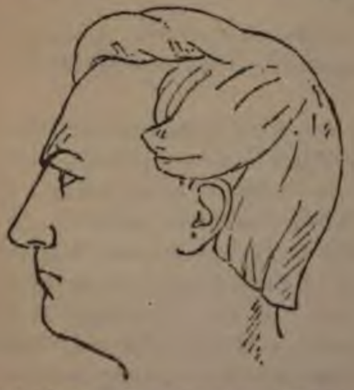

Fig. 9.—Pinched Expression, with Vertical Wrinkles.

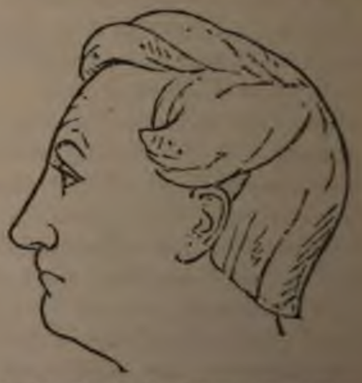

Fig. 10.—Pinched Expression, with Horizontal Wrinkles.

that of the pinched trait and vertical wrinkles with the bitter expression of the mouth (Fig. 12).

It remains to describe the complicated muscular movements that accompany a violent rage. The jaws are strongly pressed upon one another, in expression of an energy ready for the combat, of a provoking resolution; the upper lip is elevated and also the wings of the nose (bitter trait) so high that it is impossible to pinch the lips; and the teeth of the upper jaw are seen above the upward-drawn lower lip. The nostrils are swelled out wide, for the movements of respiration and the heart are precipitate in rage, and the air is inhaled and expired violently to meet an obstacle in the tightly closed teeth, so that the breathing, preferably done through the nose, is facilitated by the inflation of the nostrils. The forehead presents horizontal wrinkles as a sign of close attention, and vertical wrinkles in expression of anger. The eyes look brilliant and "flash with fire" under the effect of the mental excitement, roll wildly in their orbits, or cast a fixed and piercing look (Fig. 13).

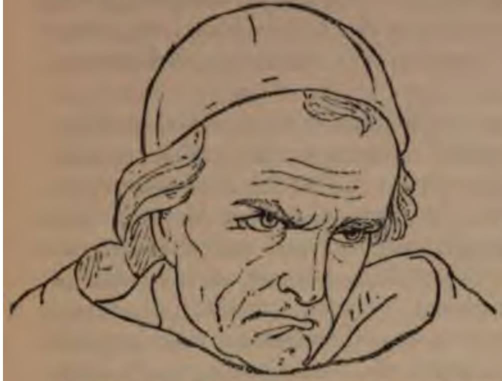

FIG. 11.—PINCHED EXPRESSION, WITH FURTIVE LOOK; HORIZONTAL AND VERTICAL WRINKLES.

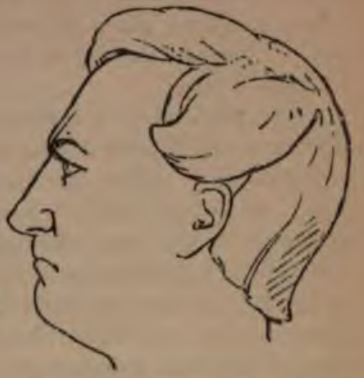

FIG. 12.—PINCHED EXPRESSION, WITH BITTER, AND VERTICAL WRINKLES.

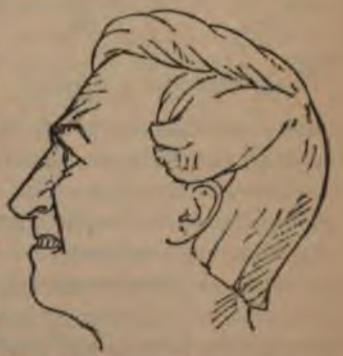

FIG. 13.—PINCHED EXPRESSION, WITH BITTER. EYES WIDE OPEN, VERTICAL AND HORIZONTAL WRINKLES, AND WINGS OF THE NOSE SWELLED OUT (EXPRESSION OF FURY).

The pinched trait becomes physiognomical most easily and frequently with persons whose daily occupations involve often or for long periods painful or intense bodily efforts, whether in the shape of a great display of force, or of special care and prudence. It may be developed among blacksmiths as well as among embroiderers, among butchers or

t we may be sure that persons with whom we find it are accustomed to do work with zeal and conscientiously. This trait can not, however, be developed physiognomically as the result of intellectual efforts and the expression of tenacity, except the corresponding states of the mind are repeated not only often but with duration. We recognize in them the *tenacem propositi virum* (man tenacious of his purpose) of Horace, the persevering man; and also, when the expression of the pinched air is engraved with a particular force, the opinionated, obstinate, headstrong, hardened man.

The expression of contempt, or disdain, is manifested partly in the eyes and partly in the mouth. A person who wishes to show his contempt raises his head in order to cast his look downward upon the object of his scorn; he thus expresses that he feels superior to the one who appears low to him—only he does not look straightforwardly at the object, but sidewise, as if he did not judge it necessary to turn his head in order to fix his eyes upon him; at the same time the eyelids droop as in sleepiness and as a sign of extreme indifference toward the real or imaginary cause. Still, a certain degree of idle and constrained attention is recognizable in the stretched appearance of the frontal muscles; the eyebrows are drawn up and horizontal wrinkles are formed on the skin of the forehead (Fig. 14). Thus, a feeble degree of contempt is expressed only in the eyes, but in the rising degrees of a haughty disdain the expression of the mouth becomes modified in a peculiar way. The bitter trait appears in the upper lip, as if the person were feeling a disagreeable, nauseating taste, and simultaneously the lower lip is pushed forward and upward, as if in the desire to remove an insignificant object from the neighborhood of the lips. The sign that the object is regarded as very insignificant is derived from the fact that in elongating the lower lip we are accustomed to blow a little puff of air, as if that were enough to blow away so light an object. Hence the mimic expression of contempt is a complicated one, and is related partly to imaginary objects and partly to imaginary sensorial impressions.

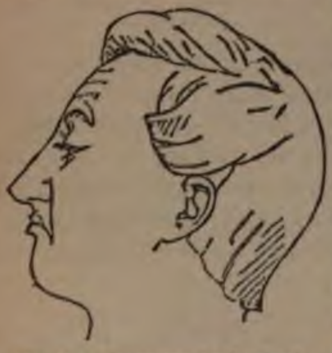

FIG. 14.—EXPRESSION OF CONTEMPT.

As in the pinched trait, the lower lip is likewise drawn up in the trait of contempt, and in both cases by means of the two levator muscles of the chin. The expression of stubbornness, however, is essentially distinguished from that of contempt by the lips being drawn inward, while in contempt the lower lip is pushed forward. This is due to a combined action of the levator muscles and of the triangular muscles of the chin; while the former push the lower lip upward and the corners of the mouth are depressed, the red edge of the lower lip is turned outward. Under the influence of the levator muscles of the chin, wrinkles characteristic of the lower lip are formed in the expression of contempt as well as in that of stubbornness; but in the latter the wrinkles start from the middle of the lower lip and are directed in a straight line toward the base and outward, like the sides of an obtuse-angled triangle, while in the former they form, by tension toward the base of the triangulars of the chin, a curved line, the convexity of which is upward (Fig. 15). In both expressions the chin is flat, because its skin, under the influence of the levator muscles, is drawn upward and tightly stretched.

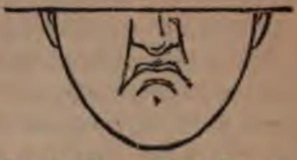

FIG. 15.—CONTEMPTUOUS EXPRESSION IN THE MOUTH.

If vertical wrinkles appear along with the expression of contempt, and the arched eyebrows and horizontal wrinkles are wanting, we judge that the person is under the influence of both anger and contempt (Fig. 16). The expressions of contempt and bitterness may be combined, as signs of a corresponding complexity of feelings. The expression of contempt occurs physiognomically with pretentious, arrogant men, who are accustomed to measure the conditions and opinions of others by the scale of their own imagined excellence, and who are hard to satisfy. This trait is manifested in the eye by highly arched brows, horizontal wrinkles, and depressed lids. In the mouth, we perceive that the middle of the lower lip seems pressed up, and that under its red border, which is slightly thrown out, an arched wrinkle is developed, the convexity of which is turned upward.—*Translated for the Popular Science Monthly from the Revue Scientifique.*

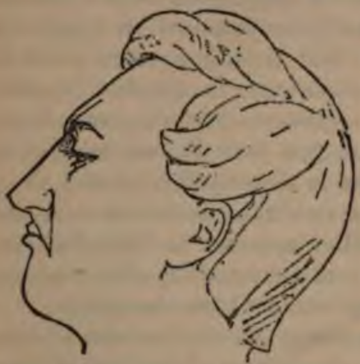

FIG. 16.—CONTEMPTUOUS EXPRESSION, WITH VERTICAL WRINKLES ON THE FOREHEAD.

IN a work on the "Constitution of Celestial Space," M. Hirn deals with the question of the existence of an ether and its possible tenuity. Among the curious conclusions that he reaches is one that the density of a medium capable by its resistance of causing a secular acceleration of half a second in the mean velocity of the moon, would correspond with a kilogramme of matter uniformly distributed throughout a space of about three hundred and ninety thousand square miles. This is a density one million times rarer than that of the air reduced to one normal density in Mr. Crookes's apparatus.

THE MEANING OF PICTURED SPHERES.

By J. C. HOUZEAU.

WHEN we take up a treatise on astronomy and come to the description of the constellations, we meet an amazing system of nomenclature. The celestial sphere is represented as covered with fictitious figures of all sorts of personages and objects, to which the stars are referred. There are heroes, like Hercules and Perseus; women, like Andromeda, Cassiopeia, and the Virgin; a giant, Orion; simple workingmen, such as a charioteer and a herdsman; a considerable number of animals, including two bears, a lion, a bull, a serpent, a crab, and a scorpion; monsters, like the dragon and the capricorn; and various inanimate objects, from a crown and a harp to a river. No other science offers so singular a system of nomenclature, so far outside of scientific conceptions. In botany, zoölogy, and topography, objects have distinctive names. We are universally accustomed to apply to the things we speak of designations that belong to them; but a system by itself, a figurative nomenclature, is applied to the groups of stars. This is a unique exception in the sciences. It is furthermore remarkable in this exception that it has held with all peoples who have made or begun a description of the sky. While the work may have been executed in isolation and in ignorance of the way followed by other nations, and the figures employed may be distinct, original, and inspired by the character of the people, the system of figuration has been the same.

There must evidently exist a cause of a general nature which has directed the thought of man in this always identical direction. There must be some feature in the aspect of the constellations different from those of other collections of natural objects and conditions which provoke a distinct work of the intelligence. This feature and these conditions we are concerned to find. It would have been no more strange to apply a figurative nomenclature to topographical groups than to the stars. Persons who first arrive in previously uninhabited countries are obliged to give names to the landmarks of the region which they will occupy; they have to distinguish the rivers and their affluents, the mountains and rocks. A chain of mountains might, perhaps, be more justly compared to a dragon than the file of stars that bears that name. The first mountain of the range might be the head of the monster, the second the neck, and the last the tail, while the lesser chains might be called the flippers or feet. This possibility is not to be rejected, for traces of a similar application are to be found in Formosa. The Chinese have, according to Ritter, put upon some of the Ta-Shan Mountains, which compose the nucleus of that island, the forms of men and figures of gods. But this is an isolated case.

When we pass to uranography, the figurative system becomes generally applied. It is well understood that the Greeks borrowed from the Chaldeans the general idea if not the details of their astronomy; and we accept their pictured sphere. Other peoples of antiquity likewise had their figured spheres, formed on the same principle—only the stars were differently grouped by each people according to its fancy, and the symbols chosen were different. Nothing better proves the independence of these constructions than this, but nothing also is more suited to exhibit what there is remarkable in this community of systems.

The Egyptians had a pictured sphere in very ancient times. Signs of it may be seen in the tomb of Seti I, at Biban-el-Moluk, and considerable developments of it in the calendar sculptured on the ceiling of the tomb of Ramses IV, at Medinet Abou. There are on this monument, which is of the thirteenth century B. C., a series of constellations designated by imaginary figures. Among them are a river, an arrow, and a lion which differs from that of our classical sphere. There are a hippopotamus and a lute-bearer; with a great asterism extending over nearly a quarter of the circumference of the sky, called the god Nacht, or the Conqueror, carrying a set of arms and ascending a stepping-stone. Another personage, Mena, is surrounded by servants. Egypt, therefore, in its uranography most distinctly followed the system of a pictured nomenclature.

The Aryans of India did the same thing in another independent manner. We find, among other things on their sphere, which was completed in the ninth century before the Christian era, a stork, two swine, a large tree with a dog in it, an Ethiopian with a giant's features, and a woman covered with a cloak. The Chinese adopted the system of small groups, and consequently considerably multiplied the number of denominations, so that their sphere bears more than three hundred names—names of personages and objects—forming in fact a figurative system. Here are the celestial pivot, precious stones, a bushel-measure, a woman embroidering, the sovereigns of the sky, and a number of the dignitaries of the Celestial Empire. The Arabs, previous to the time of Mohammed, also had a figured nomenclature, with a camel, a jackal, a sheep, an ostrich, and a dog; among inanimate objects, a tent, a crib, a pot, a plate, a cubit, and a well-bucket. The Great Bear was a coffin, followed by the three stars in the tail as three mourners. While the groups were independent and the figures unlike, the system of figuration still prevailed.

[illegible]s all had complete uranographies, covering every part of the sphere that they could perceive above their horizon. Others, of a less advanced civilization, only named the more conspicuous groups of stars. They merely made a start. Yet the problem presented itself everywhere under the same aspect, for the solution was much of the same kind. Thus, the Scandinavians had a dog, a chariot, a cross, and a spindle in the sky. The Eskimos put seal-hunters there. The Makah Indians of the strait of San Juan de Fuca, living on the sea-coast, chose figures of fishes and cetaceans. The Aztecs and Mayas saw animals there, including a scorpion, which does not correspond with our constellation Scorpio. The Peruvians designated a jaguar, a cross-bearer, and a sheep suckling her lamb. The Puelches of Patagonia set ostrich-feathers in the Magellanic clouds. The Oceanian peoples applied figures to the constellations that impressed them.

These facts will lead the reader to ask if the resemblance presented by the configurations of some of the stars with familiar objects has not provoked comparisons of which the pictured sphere is a result. Thus, the constellation Gemini is composed of two lines of stars, each beginning with one of the first magnitude. There is a striking duality in this, which has seemed to suggest the same representative idea in many quarters. But the Accadians, who gave us the constellation of the Twins, did not figure it as we do, nor as the Tahitians do. Instead of arranging the brothers side by side, they opposed them foot to foot.

The small number of similitudes that we meet in the spheres of peoples distant from one another have an important significance. The Pleiades were nearly everywhere the first group that was remarked and named. The agglomeration of stars in it was of a nature to provoke the same kind of impressions. Yet different peoples attached different figures to it. The ancient Egyptians were struck by the idea of number, and, running into a prodigious exaggeration, called it by a name that signified thousands. In India they saw a hen and chickens in the group. This name spread thence to western Asia and then to Europe, and is still common. The similitudes were different in the New World. The Eskimos called the group the "bound together"; in a great part of North America the thought is of a dance—with the Iroquois, of men and women; with the Chokitapias, or Blackfeet, a sacred dance around the sacred seed. We may pertinently recollect that in classic antiquity Hyginus said that the Pleiades were so disposed as to seem to be dancing around.

The second stellar object that impressed primitive peoples is the milky way, which naturally suggests the idea of a road and a river. It is called the celestial river in China. To the ancient poets it was the stream of milk which Alcmene spilled when nursing Hercules. To the philosophers it was the highway of souls and had two gates, at the two places where it intersects the zodiac. The souls entered the world by the gate of the Twins (which corresponds with the sign Cancer), and left it to return to the gods by the gate of Sagittarius (sign of Capricorn). It is a little remarkable that some of the American nations also called the milky way the highway of souls;* but it does not appear so singular upon reflection. The milky way certainly resembles a road in its shape. Let us now recollect that a large number of people consign the souls of their ancestors to the sky; hence the idea might easily have occurred frequently. There has also been a fortuitous and unconscious agreement among nations to give the name of the Bear to the most brilliant constellation in the neighborhood of the north pole. The primitive Sanskrit name of this constellation, according to Prof. Max Müller, meant "chariot," and this was the original image, which survives among some of our people to the present. But as the same word, *riksha*, also designates a bear, there has sometimes been confusion, and the image of a bear was placed by the Greeks on the classic sphere. A bear was also represented by the principal North American Indian nations in the quadrilateral of this constellation. Only, these nations, who were familiar with the bear, did not include in the same constellation the three stars of what we call the tail, because the bear has only a very short tail, and this inclusion would have made it monstrous; so they fancied them three hunters pursuing the bear.

Now, is there anything extraordinary in the coincidence of like similitudes in the Old and New Worlds? We do not think there is. The bear is a polar animal. The constellation is large, and demands a large symbol. Facts prove this, for the constellation was a reindeer with the Eskimos, an elk with the Indians of Puget Sound, and an elephant with the Hindoos. The fortuitous coincidence of names in two different centers does not, therefore, seem hard to explain. It only implies that there is a resemblance with the adopted image in the aspect of the constellation. We should also consider that, within the limits of a certain compass of ideas, the number of objects to which it is possible to recur is restricted, and two peoples may be led by chance to select the same symbol for the same group of stars. This is visibly the case with the constellation Cancer, which is represented in Japan by another crustacean, the many-fingered limulus.

I shall not insist upon the coincidence which La Condamine thought he had found, respecting the constellation Taurus, among some of the Indians of the Amazon. It is now understood that the term by which these Indians designated the Hyades did not n[illegible] a bull's jaw, but a tapir's. The examples of identity or of

[illegible] des sauvages Amériquains," 4to, 1724, vol. i, p. 406.

seeming identity in the images are therefore reduced to a small number of comparisons. They are exceptional cases, in which the aspect of the asterism may have had something to do with the suggestion of similar images. Aside from this there is nothing in common: the figures set in the sky upon the constellations were peculiar to each people; they were arbitrary creations, and that proves that the outlines formed by the stars did not directly suggest either personages or animals by which the imagination was struck. Apart from a few geometrical figures—a quadrilateral, a triangle, or a cross—the configurations of the stars presented no relations with the objects selected to designate them. We are dealing, then, with a fanciful creation by each people, in which each one exhibited the peculiar tendencies of its imagination and genius.

This circumstance renders the nomenclature in question still more remarkable, since there is nothing or hardly anything in the aspect of the celestial tableau to provoke the construction of it. We return to the question with which we started: By what cause has a nomenclature so strange, unique in its kind, possessed, in a seemingly inevitable way, all the peoples who have looked into the sky? For we might predict, from the generality of the method, that if some new people, having everything to begin again, should start to construct its system of knowledge, it would again make a pictured sphere for the stars. I will not pretend to answer a question of scientific archæology that has not been sounded, not even outlined, till now. If I suggest a solution, it is simply as an essay and hint, leaving it to professional students of folk-lore to enlighten us more fully. It sometimes seems to me that we might draw some indications of a comparison between the manner in which places in hitherto uninhabited countries are named and the nomenclature of the stars.

When immigrants arrive in countries without inhabitants and unmapped, the first names given to the natural landmarks—the rivers, hills, clumps of trees, and rocks—are descriptive ones. These names often survive after the first arrivals have been dispersed and replaced by other peoples; and we know how ethnographers find, in geographical appellations, the track, the limits, and the language of the ancient inhabitants of a country. In such primary nomenclature, they say, for instance, the blue water, the green mountain, the brown rock, the cedar wood, the steep cliff, etc. It was the natural course, which has been followed everywhere. Why has the human mind taken a wholly different course for the sky? Was it not because the multiplicity of objects and their great resemblance had exhausted the series of descriptive terms? Multiplicity often confuses the judgment; for it is known that the view of the sky conveys the impression of a larger number of stars than are really seen there. We instinctively halt before the seemingly impossible task of finding distinctive epithets for so many stars and asterisms; for, after a few such qualifications as blazing, sparkling, pale, trembling, etc.—perhaps there are twenty of them in all—we find that words fail.

We suggest this explanation tentatively, without attaching particular importance to it. But we invite the serious attention of archæologists, and psychologists as well, to the singular phenomenon in mental evolution which the case of the pictured spheres discloses. It derives interest from its unique character as a nomenclature, and from its being reproduced, without exception, in all the centers of evolution. There is evidently something in the constant return of this process that comes from the very laws of our nature.—*Translated for the Popular Science Monthly from Ciel et Terre.*

SKETCH OF A. F. J. PLATEAU.

By SOPHIE BLEDSOE HERRICK.

ANTOINE FERDINAND JOSEPH PLATEAU was born in Brussels, October 14, 1801. He was brought up in the midst of artistic influences, his father having been a flower-painter of great talent. From his earliest childhood the boy exhibited not only remarkable ability, but clearly manifested the bent of his mind. When scarcely more than a baby he showed the greatest delight in some physical experiments which were made in his presence.

In the days when Plateau was a child, very little attention was paid to natural bent by parents in the selection of a life-work for their children. The idea of the hereditary transmission of occupation dominated all others. The boy, with no taste for art, was devoted at an early age by his father to the study of painting.

At fourteen years of age he became an orphan, and with his two sisters was left to the care of his uncle—M. Thirion, an advocate. Soon after this his health, which was never strong, showed signs of failure; and his uncle sent the children to a little village near Waterloo. It was upon the eve of the battle, and the villagers took refuge in the depths of the forest of Soignes, where for two days and nights they remained in the open air, sleeping at night before a great fire, and living upon potatoes which were baked in the cinders.

The boy seemed scarcely conscious of the violent detonations ook the ground beneath them, he was so absorbed in his of catching butterflies. The panic over, the villagers went back to their homes, and Joseph and his sisters remained some time in the little village of Ohain.

As soon as his health was restored he returned to his art studies. Here he made such excellent progress that one evening Prince Frederick, the son of the king, who was visiting the establishment, was attracted by the boy's work. When he found that Joseph was an orphan, he said, "Well, from this moment I take you under my protection." Later, when M. Thirion wished to remind the prince of his promise, he was deterred by the boy's unwillingness to make any claim upon him.

Painting occupied Joseph by day, but in the evening and in his leisure moments his beloved physics employed all his time. With the aid of some young friends he organized *soirées*, the entertainment being experiments of his own devising, made with apparatus constructed by himself.

At sixteen years of age he entered the Athenæum at Brussels. He omitted certain studies, but in all that he undertook he distinguished himself by his enthusiastic progress. His masters became at once interested in their brilliant pupil. The friendship of Quetelet, which became stronger as time went on, proved of the greatest benefit to him in later life.

His school-life over, the subject of a profession presented itself for reconsideration. His uncle pressed upon the boy the study of law, as the noblest of all professions, and Joseph consented. In choosing art there had been no great sacrifice; he had been too young at that time to know his own mind; but he felt a strong antipathy to the law.

This dislike did not prevent honest and conscientious work in the pursuit of his legal studies; but the physical sciences held for him their old fascination, and he made the rather singular compromise of studying both law and physics, and doing himself credit in both alike. His faithful work had its reward at last: his uncle, seeing his determination, and at the same time his willingness to be guided, withdrew his opposition, and the young student gave himself up wholly to scientific pursuits.

The care of his younger sister now fell upon Plateau, and, pressed by the necessity to provide for them both, he accepted the professorship of elementary mathematics in the Athenæum at Liége. This was in 1827. In 1829 he received the degree of Doctor in Physical Sciences and Mathematics, and from that time he gave himself to original research.

During this year he devoted much time to experimenting upon various points in regard to vision, to the persistence of impressions upon the retina, subjective color, etc. On one occasion, to determine some point, he looked at the sun for twenty-five seconds with the naked eye. For many days after this hazardous experiment his eyes were strongly affected, but he did not suspect that he had done them a permanent injury. This experiment undoubtedly laid the foundations of that disease which twelve years later brought on total blindness.

After being forced to resign his work, in 1830, he again resumed it at Brussels. In 1835 Quetelet urged Plateau to apply for the professorship of experimental science in the University of Ghent. The young *savant* refused at first to offer himself as candidate for a position in the first institution in his native land, pleading youth and inexperience; but later his scruples were overcome, and he received the appointment to the chair.

As soon as he began his work in Ghent, he found the collections of the university very poor and meager. He gave himself at once to the work of remedying this deficiency. In order to inform himself, he visited and examined minutely the most celebrated collections in England, France, and Germany. He addressed the Government and the inspector of the university, and pleaded his case so well that in the end—though it was only after long and wearisome labor—he succeeded in securing one of the finest physical cabinets in existence to the University of Ghent.

In 1840 Plateau married Mlle. Clavareau, daughter of a director of tax-collections. She was always a devoted wife and true helpmate to him. Outliving him, she was able to comfort, sustain, and help him when darkness settled over his life. In 1841 his son Félix, now Professor of Zoölogy and Comparative Anatomy in the University of Ghent, was born. During the same year the disease which ended in total blindness made itself felt. For two years he submitted to the most painful treatment in hopes of saving his eye-sight. The trouble which had attacked the right eye extended to the left. During these long months neither his terrible affliction nor his excruciating suffering ever drew a word of complaint from his lips.

The courage which showed itself in this heroic endurance was far from being merely passive. Nothing daunted by what, in a lesser man, would have ended his life's work, Plateau never lost courage. The future must have looked very dark even to his courageous spirit, but he gave no token of failure. Happily, all material anxieties were removed by the action of his countrymen. He was appointed "professeur ordinaire," and a little later a royal order, countersigned by M. Rogier, assured him of the enjoyment of the entire salary and emoluments of his position. A noble recognition of the man and of his services—a recognition fully justified by forty years of fruitful work, and by a series of discoveries "which have made Belgian science illustrious throughout the entire world."

As soon as Plateau found himself fairly out of the physicians' hands, with restored health, he resumed his experiments with ardor. He was most happy in finding co-laborers who gave him the most efficient and willing help. "Thanks to their generous co-operation," said he, "the career of scientific work remains open to me. I can, in spite of the infirmity with which I have been visited, put in order the materials which I have amassed, and even undertake new researches."

When this experimental work began again, Plateau showed at once that the clouding of his physical sight had only served to clarify his mental vision. At first he could not give up his independence, and for some time he wrote between metallic slips; his assistants soon learned to decipher the writing. Later, however, he gave up this habit, and contented himself with writing to dictation.

His temper was usually calm and equable; he never uttered a complaint on account of the many deprivations which his blindness imposed. He was bright and amusing in his conversation, and yet he was, as all thinkers are, in the main, sober.

His memory, which was naturally a good one, had become phenomenal by cultivation. It was only necessary to hear an ordinary poem read once or twice for him to be able to repeat it accurately. This gift was one of his greatest compensations for the loss of sight, and of incalculable benefit in his experiments made by the hands of others. His method, given by his son-in-law and biographer, G. van der Mensbrugghe, is as follows: In a day devoted to experiment, speaking of the latter years of the physicist's life, he says: "The old man's face is animated; he announces with admirable precision all the precautions to be taken that the apparatus should work. According to his often expressed desire, the assistant acquaints him successively with his operations, even to the smallest point. No manœuvre is left to his personal valuation. The apparatus is at last ready to be set in motion. The master, who imagines and regulates all the dispositions, makes still other suggestions; he assures himself by different means that all is ready in accordance with his will. At last the assistant is asked to operate—the experiment succeeds! What a satisfaction, what a relief for the noble worker who has conceived it! For greater assurance he causes it to be repeated, with various modifications suggested by the descriptions of the observed effects. If all passes as he has foreseen, he at once asks his secretary to write to his dictation all the details of the experiment. No point is forgotten, for the provisional wording ought to represent, as exactly as possible, all that had been verified. But if the observation did not meet his expectations, in spite of the precautions he had deemed necessary, the physicist promised himself to think it over again. He would then devote a part of the night to revolving the question again and again under all its aspects, to seek the cause of the failure and the means of future success."

His enthusiasm would sometimes put his assistants' patience to a rather severe test, and he would cry out, "Oh, if I could only *see!*" but as soon as success crowned his efforts, the indefatigable experimenter loved to express his gratitude. He cross-questioned Nature with more severity because he could only receive her answers by the voice of an interpreter. The thousand obstacles that presented themselves because of his infirmity only suggested a thousand precautions in order to surmount them. His inner vision was so preternaturally clear that he often corrected the observations of his assistants, and taught their eyes to see aright.

The love of scientific accuracy is not so much a mental as a moral quality. Plateau was possessed of a supreme love for truth, which not only made him accurate in his investigations and in the records of his experiments, but it made him careful not to judge others without a full knowledge of the facts. Always ready to ascribe scientific discovery to the right persons, he spared no pains to know who was the true discoverer.

The instructions which he gave to his pupils bore his own peculiar stamp. He used simple language and almost a conversational tone. His phrases were short, incisive, and clear, a fitting medium for the expressions of a mind so unclouded, so direct, and so concentrated. His talents as an experimenter were even more marked than as a speaker—more marked, because it is a far more uncommon gift.

He was an old-fashioned believer. The more deeply he "penetrated into the secrets of Nature, the more he inclined toward the mysteries of the supernatural order," says his biographer.

The picture of his home-life—his delight in and tenderness for his children in his early manhood, and the same gentle benevolence shown toward his grandchildren in his old age—is very beautiful.

As a scientist he is held in very high esteem by the greatest of his contemporaries. Honors were showered upon him by the great scientific societies of Europe. Such men as Arago and Faraday were glad to do him honor.

His earlier work was confined to the subject of the persistence of luminous impressions upon the eye and the determination of several simultaneous impressions under various conditions of motion. Many of the scientific toys of to-day are the outcome of facts and laws established by him, though he is not often accred- [illegible] earlier discoveries. With the study of persistence [illegible] is so closely associated subjective color that this soon came under consideration, both accidental color which follows an impression and that caused by juxtaposition. He simplified the subject greatly by making this division of the subject, the first class including all appearances which succeed the contemplation of a bright-colored object, the second those which accompany such contemplation. The phenomena had been observed before, but Plateau was the first who reduced them to law.

Some valuable experiments and formulated theories on the subject of irradiation were begun, but was interrupted by his oncoming blindness.

Before this time, Plateau's attention had been fixed by the spherical form which a drop of oil assumed when introduced into an alcoholic liquid having the same specific gravity as the oil. From this small beginning he developed a most wonderful series of experiments and laws under the title "Memoirs upon the Phenomena which a Free Mass of Liquid presents when removed from the Action of Gravity." Eleven papers upon this general subject appeared between the years 1843 and 1868 in the memoirs of the Academy of Brussels. These included his experiments upon films and the formulation of the laws which govern their union—one of Plateau's most valuable contributions to physical science. He also made some very interesting investigations upon liquid jets, with a number of shorter papers and notes upon various subjects. Most of these papers appeared in the memoirs or bulletins of the Academy of Brussels, a few in the French and German annals of science, "Comptes Rendu de l'Académie des Sciences de Paris," and Poggendorff's "Annalen." He died September 15, 1883.

It is impossible to read of Plateau's work, carried on for so many years in spite of frail health and total blindness, and not draw a parallel between Huber and himself—each of them a man who was the peer of any worker in his own field, though so cruelly handicapped. They are two of the purest, noblest, most pathetic, most heroic figures who adorn the annals of science.

WHILE believing it premature till some new groups of lines are further studied to express more than provisional suggestions as to the nature of certain nebulæ he has been examining spectroscopically, Mr. Huggins supposes that they may represent an early stage in the evolutionary changes of the heavenly bodies. They consist probably of gas at a high temperature and very tenuous, where chemical dissociation exists, and the constituents of the mass are arranged in the order of vapor-density. But the stage of evolution which the nebula in Andromeda represents is no longer a matter of hypothesis. Recent photographs show a planetary system at a somewhat advanced stage of evolution. Already several planets have been thrown off, and the central gaseous mass has condensed to a moderate size as compared with the dimensions it must have possessed before any planets had been formed.

CORRESPONDENCE.

A FALLACY OF THE SOCIALISTS.

Editor Popular Science Monthly:

DEAR SIR: Is not the land question, viewed from an American standpoint, simply a disagreement about methods rather than ethical principles; and are not the distinctions sought to be established between absolute and relative political ethics more subtle than philosophical or accurate?

A great part of the land in the United States was in the beginning, and much of it is still, just in the condition demanded by Mr. Laidler and his *confrères*—the absolute property of the Government. Almost the whole country was at first "held by the great corporate body—society," without any suspicion of "violence, fraud, the prerogative of force, or the claims of superior cunning" in any way affecting the sources to which titles are traced. Government was free to do as it would with its possessions: either to sell, lease, or farm them in its own behalf. Government—that is, society—chose to sell or give away the public domain in fee-simple, reserving the right of eminent domain. The moment land is reduced to private ownership, it becomes subject to taxation, and must bear its share of the burdens of society. It contributes toward the maintenance of roads, schools, infirmaries, hospitals, and all the complicated machinery necessary to the well-being of the social fabric. If land, subject to private ownership, fails to pay its tax assessments, it is forthwith confiscated and reverts to the state, which finally sells it, without possibility of redemption, to some other person who will pay the taxes—that is, contribute to maintain society. Who decides what amount of burden land shall bear? Not the private proprietor certainly, but society. No private owner can evade this implied contract—namely, to contribute as much to the support of society as society may deem necessary. Hence every citizen may be said to have an interest to the extent of his political or social influence in all the lands of the commonwealth. And the tenure of every landholder depends on his ability to meet the burdens laid upon his land by non-owners, since these everywhere constitute a majority. Strictly speaking, therefore, there is no such thing as private ownership of land in the sense in which the expression is used in the discussion. The owner may sell, lease, or bequeath his holding; but the usufruct of society, which exists prior to all other claims, can not be avoided. Mr. Laidler's assertion, therefore, quoting from Mr. Spencer, that if men may make the soil private property, "then the Duke of Sutherland may justifiably banish Highlanders to make room for sheep-walks," is fallacious. This false assumption invalidates equally all of the ten sections which compose his argument. As land tenures exist in the United States, the landless men, instead of becoming subject to "expulsion from the earth altogether," would be far more likely to bring about the confiscation of all of the duke's vast possessions by the legitimate exercise of their constitutional powers of direct and indirect taxation.

It may be urged that the existing tenure of land in the United States does not represent the status of private ownership in older and densely populated countries, and still less so that possible condition of the earth and mankind contemplated by the expounder of absolute political ethics. The obvious reply is, that neither condition is essential to the continuation of private ownership. Let the Socialists direct their complaints against hereditary privileges and the abuses of private ownership, and not against that coincident form of land tenure which, when properly adjusted, is best adapted to realize their views.

If all lands in Great Britain could be suddenly transferred to the crown, is there any way in which society could better manage or dispose of them than the United States has adopted? No better way, certainly, has yet been indicated. Government here—notably the State of Ohio in the management of her school lands—tried for many years all known methods of leasing these lands, and all ended in conspicuous failure. Her public men universally denounced the system of leases, after experimenting with it in all possible ways, until an act of Congress authorized the school lands to be sold. If society, after actual experience, has condemned and abandoned the methods advocated by the Socialists, and adopted the existing form of private ownership as the best which statesmanship has to offer, what reason is there to suppose that the resumption of public ownership, if it could be accomplished, would lead to better results in the future? Under the present form of private holdings, land is made to yield the largest possible returns, and to contribute of its products the largest possible contingent for the benefit of the landless. Can any theory of government or system of philosophy be true which is inconsistent with obvious facts?

JAMES L. TAYLOR.

WHEELERSBURG, OHIO, *December* 30, 1889.

A DEFENSE OF "ADVANCED" WOMEN.

Editor Popular Science Monthly:

I HAVE read the article by Grant Allen in the October number of "The Popular Science Monthly," and I wish to say that if I knew even one woman of "advanced" ideas holding the opinions he attributes to them I should value the article in that proportion; but as I do not know a single one—and I have lived a good deal among women of "advanced" ideas—I can not help thinking the article worse than uncalled for.

As far as I know anything about it, those who shirk the duties of maternity have ideas very far from advanced: they are the poorer kind of society women, many of whom would be horrified at being suspected of intelligence or independence.

The charge used to be that women became spinsters because they could not get husbands, and that was considered sufficiently opprobrious. Now Mr. Allen charges them with unwillingness to take husbands; and yet states in the same breath that the marriageable men go off beyond reach when they "ought to be making love," etc.

Here is an arraignment indeed! Why not devote an article—any number of articles—exclusively to these marriageable men?

The great body of noble women who have thrown themselves into the struggle for equal freedom are behind no one in desire for true womanliness and femininity. Already we are well on the way to the emancipation that Mr. Allen pleads for, the sound bodies and minds that are to come from the free and entire development of girls and boys, and freedom from Mrs. Grundy; but all the progress made is due to these "women-question agitators."

If there exists this deplorable indifference to marriage on the part of women, is it not the consequence of the very state of things that these leaders are striving to abolish—and also, perhaps, of the sacrifices that this strife entails, and of some of the characteristics that are inevitably developed by it, and that no one knows or deprecates more than these valiant workers themselves?

All reforms have their attendant evils; but it is the state of things that called for the reform that is to blame for them—or the "nature of things."

We need patience, hands off, fair play without privilege, and that each should think most of his own duty. A. A. M.

Boston, *December* 15, 1889.

PUBLIC SCHOOLS AND CRIME.

Editor Popular Science Monthly:

As I have more than seven hundred pupils under my charge, and that, too, in a State not backward in common-school education, I venture to protest against being lodged in a criminal-making class. Like Mr. Reece, I would ask, "Of what utility are facts and experiences unless their teachings are heeded and their meaning properly interpreted?" With Mr. Atkinson, I say, "All statistics, unless qualified by sound judgment, are mere rubbish."

Mr. Reece mentions the fact of the increase of criminals since the period of modern civilization and science commenced, but he does not mention that the methods of tracking criminals have wonderfully increased, so that we may have a larger ratio of criminals *caught* than in days before the swift post, the telegraph, the police system, the photograph, and the extradition treaty. Surely he should give the public school the praise of supplying some of the means of catching the criminal after it has made him! I will say nothing about the increased accuracy of the statistics of 1880 over those of the earlier period.

While discussing criminality in New York State, he states that the common schools furnish eighty-three per cent of the inmates of Auburn and Sing Sing, while a little over nine per cent is credited to the illiterate population. Out of 2,616 convicts, 1,801 are credited to the common school and 238 to the illiterates. I can not see that even his own arrangement of the figures is against us. Surely nine per cent is a much larger ratio, when compared with the number of illiterates in New York, than eighty-three per cent would be if compared with the number of the common-school graduates. It seems to me that he should have taken as bases for his example in social arithmetic the number of illiterates and the number of common-school graduates. I have not the statistics of illiteracy in New York at hand, but I believe the figures will show fully three times as large a ratio of criminals to be credited to them as to the common school.

Mr. Reece cites various savage tribes as being examples to us in morals. He fails to see that temptations are increased a thousand-fold for the civilized man. There could not be many thefts where all property is held in common, when the property owned is so paltry as not to be worth the carrying away.

I do not contend that the public school is doing all it is able, but it is doing as well as the church and the family are doing in their spheres toward elevating the moral tone of the community. Writers like Mr. Reece seem inclined to find fault with us because we can not do the work of the family and the church. We are doing a good share of it, but, under the triple burden, we may sometimes fail to send out all good citizens. Very truly, Charles S. Davis.

Lynn, Mass., *January* 12, 1890.

A NOVEL WATER-COOLER.

Editor Popular Science Monthly:

My article in the January (1890) number of the "Monthly" brought me an inquiry from Quincy, Illinois, as to where the writer could get an olla (pronounced o-ya), and what it would cost. Here in southern California they are plenty, and the regular retail price is twenty cents a gallon. What the transportation would be I do not know.

Since my article was written I have heard of another way of keeping water cool, which I have never seen exemplified. A grain-sack, such as is used by the Eastern farmers, is painted and filled with water, and hung up in a cool place where the breeze strikes it.

The olla, too, must be kept in a breezy place. Wind will dry clothes or a field, and so it will evaporate the water oozing through an olla, or barrel, or, I suppose, the painted grain-bag. The evaporation is what does the cooling, according to a well-known principle of physics. HENRY J. PHILPOTT.

PASADENA, CAL., *January* 13, 1890.

THE LUCAYAN INDIANS.

Editor Popular Science Monthly:

SIR: With reference to Prof. Brooks's paper, "The Lucayan Indians," in the November number of the "Monthly," I have examined one or two caves during the past summer, and have been intending to make a more thorough search during the winter; so, if any of your readers should feel inclined to adopt the professor's suggestion, I shall be glad to co-operate.

Although no doubt the aborigines of the Bahamas had intercourse with Hayti and Cuba, the possession by them of stone implements does not, as Prof. Brooks supposes, prove it; for, although the islands consist solely of coral rock, yet stone, identical in appearance with that of which the stone implements are usually made, is constantly being washed up on the northern shore of New Providence, and probably elsewhere; so that the Lucayan implement-makers would have had plenty of material in the archipelago.

Also, it must not be too hastily concluded that all remains found in caves in the Bahamas are Lucayan. Negro skulls have been found more than once, and in one cave I found, consolidated into breccia, a number of bones which a local anatomist pronounced to be those of "some large vertebrate animal." They presented an appearance of great antiquity, and, had we not known that there were no large animals in these islands at the time of their discovery, they would certainly have been referred to pre-European days; whereas, they were probably the remains of an ox which had been killed and eaten by runaway slaves, for the surface of the rock showed traces of fire. Yours faithfully,

A. B. ELLIS.

NASSAU, N. P., *November* 28, 1889.

EDITOR'S TABLE.

HOW TO MAKE KNOWLEDGE REAL.

THERE was an interesting discussion a month or two ago at a meeting of the Chicago Institute of Education. A paper had been read by one of the members of the Institute, Mr. Fernando Sanford, on "The Disciplinary Value of Scientific Study," which is stated to have been a strong and well-constructed plea for the study of science by original observation rather than by the ordinary text-book methods. Many of our readers would expect that unqualified assent would have been given to the argument of the paper; but it happened that an eminent educationist was present in the person of Superintendent Howland, of the Chicago public schools, who dissented entirely from Mr. Sanford's thesis. He thought all this talk about observation of facts and handling of objects was great nonsense; why not let children learn out of books that things were so and so, and commit the facts to memory? What was the use of all the accumulated knowledge and intelligence of the ages, if children were to begin at the beginning and make over again for themselves discoveries that were made centuries ago? Life was too short, he held, for this kind of thing. Let the pupil start with the knowledge of his own day as gathered and garnered in books, and not bother to find out things for himself. Moreover, man and his institutions are more worth studying than all the world besides. It would be a misfortune, he thought, if the advice given in the paper were followed in the schools.

We take the report of this speech as we find it in the columns of our contemporary "Intelligence" of Chicago, and we judge by the remarks that followed that the meaning we attach to it is precisely that which it conveyed to those who were present. These views, expressed by a man holding a most important official position, and eminent as an educational leader, are so strikingly opposed to the general verdict of scientific educators as to challenge examination. The question is, how shall science be taught? Only experience can answer. If there is any fact that experience has overwhelmingly illustrated and established, it is that mere book-teaching of science is void and of no effect—nay, that it is worse: that it has an actively injurious effect on the mind, which it deadens with meaningless jargon and befogs with ill-comprehended notions. The highest scientific authorities have proclaimed this; and a committee of the American Association for the Advancement of Science put on record three or four years ago their deliberate opinion that the book science taught in the schools of this country was valueless for any purpose of intellectual discipline. Superintendent Howland must have observed in the course of his wide experience how hollow and often how fantastically absurd are the ideas children acquire of things of which they are told, but which they have never seen or handled. Every one who has been a close observer of his own contemporaries must be aware of many a man and woman who, for want of early and practical familiarity with this or that class of physical facts, labors under a confirmed disability in dealing with all facts of that particular order. How is a knowledge of or interest in flowers and plants (for example) to be acquired, if not by personal handling and observation of the objects themselves? And are there not many persons who, for want of this practical training, go through life with little knowledge of flowers beyond the fact that they are of various colors and odors, and of plants that they are for the most part green and require soil and sunlight for their growth? Many a man will give abundant testimony showing how hard he has striven in mature years to gain a little knowledge from books of this or that branch of science, and what terribly uphill and, in the main, ineffectual work it has been, just on account of defect in his powers of observation, and in that memory for the forms and qualities of physical things which due exercise of the observing habit in early life develops. Take any man on the ground that has become familiar to him by actual observation, and he is at his best. Talk to the sportsman about guns and game, and you are amazed at the profusion and minuteness of his knowledge. Talk to the naturalist, and he is inexhaustible in his descriptions and explanations of the objects of his craft. Talk to the geologist, and you will find that the strata and their fossil contents are the true realities amid which he lives. But talk to any man about that which he has only learned from books, and, though his speech may be copious, it will lack a certain living quality that comes only from conversance with realities. Even in such a domain as history, which some may say can not be learned except from books, there is a marked difference between the man whose memory is simply laden with names and dates, and the man who has become, in a sense, practically acquainted with the memorials of past ages—who has studied their monuments, their arts, their coins, their charters, their institutions, and who has vivified the whole by a knowledge of similar things belonging to the present time. It is safe to say that no man will ever understand history from the mere perusal of a narrative; he must, in a manner, make himself a contemporary of the times he is reading about; and then he may know the past a little as an intelligent man of affairs knows the present.

We had a splendid example here in this city not many weeks ago of what book-teaching of science amounts to. The "Evening Post" gave a selection of over fifty answers given by young women of the average age of seventeen, all pupils of our public schools, most of them having gone through the highest grade, to five very simple questions forming an examination paper set for candidates for admission to a free stenographic class at the Cooper Institute. These damsels were asked, among other things, to state how many motions the earth has, and how much time each occupies; also what causes the change of seasons. These things had been fully explained to them, as was supposed, at school; and all, or nearly all, had in point of fact retained some shreds of the phraseology in which the explanations had been conveyed. Here are some examples of the answers to the question as to the motions of the earth:

"One motion. One year. The motion of sun round the earth."

"Two motions. Night, Day, twelve hours for each."

"Four motions, it revolves on its axis around once a year, and the four motions cause the seasons spring, summer, fall, and winter."

"The revolution of the earth on its axis, and the inclination of 23½ per cent of its poles to the plane of its orbit."

"Two motions, day and night. The sun causes the earth to move around its axis every twenty-four hours."

"Two, Regular and Circular, twelve hours for each."

"If the earth would not be round, the sun and moon could not go round the earth. Sun takes twenty-four hours. Moon takes twenty-four hours. Stars at night."

We can not afford more space to this rubbish. Suffice it to say that our contemporary prints the answers given to the several questions by fifty-six of the candidates, and that they *all* display the most deplorable ignorance and confusion.

The problems of how science shall be taught in the public schools, or indeed whether it shall be brought into them at all, depend for their solution upon having the right kind of teachers. They need to realize the utter ignorance of the child-mind as it comes for instruction to the public school, and to understand how to build up in that mind a fabric of real and coherent knowledge. Let us turn children out of the public schools ignorant, if need be, of many things that are taught to them now; but let this idea at least be rooted in their minds, that this world is made up of real things; and this further idea, that words are worse than useless unless they can be applied in the most definite manner to well-understood objects of sense or of thought. What a blessing it would be if we could inspire the rising generation with a real horror of vague and meaningless language! It would mean nothing less than an intellectual revolution in the world—or at least in our considerable portion of it.

THE RECOGNITION OF TRUTH.

If there should arise a class of men who were able to distinguish, promptly and invariably, genuine things from imitations, facts from falsehoods, and truth from error, they would have an almost inconceivable advantage in the struggle of life. The tricks of impostors would never deceive them; the bubbles of visionaries would never delude them; they would never be misled by the sophistries of shallow theorists; never be enslaved by baseless superstitions. Such wisdom is so unlike what the world has ever known that the idea savors of Utopia or the millennium, and to express it seems almost childish. Yet it is a fact that some progress toward this ideal has been made—some increase of the power of recognizing truth has been gained. A class of men has arisen whose pursuit of health is not hampered by the delusion that disease is a punishment for lapses from religion, who do not waste their money on schemes for getting more power out of a machine than is put into it, who do not accept every statement that is put to them with rhetorical vehemence and defective evidence. This superior discernment—far from perfect, but the best that man has ever had—

is the possession of those who have adopted the scientific habit of thought. A writer in the "Lancet" remarks that a supersensitiveness with regard to truth is the essential characteristic of a scientific frame of mind. Every suggestion that is offered in explanation of phenomena which are imperfectly understood is received with cautious reserve. This characteristic is liable to be mistaken for uncertainty or for prejudice; but in reality it is solely the outward sign of a just appreciation of the numerous sources of fallacy, which so often tend to render the most brilliant speculations worthless, when examined rigidly and coldly by the ideal standard of truth. When gauging the probability of the truth of any suggested explanation, it is held to be scientifically unsound to welcome it merely because some one of undoubted honesty of purpose has expressed his entire belief in it. There is always the possibility of mental bias to be reckoned with, as well as the possibility of unconscious delusion. No single sense is to be implicitly trusted. A preconceived idea may lead to the recognition of one property, while others of greater importance are overlooked. Pushed to its logical conclusion, this ideal standard of truth demands more proof than can ever be obtained, and for working purposes it is found convenient to employ what may be called provisional truths, which we accept on account of the facts that appear to support them being vastly more numerous than those that appear to oppose them, or because they have been set forth by careful, conscientious observers, after thorough consideration and elimination of all probable sources of error.

Imperfect education fosters delusion; indeed, delusions are most rife with the ambitious condition which often comes from "a little learning," when the whole is liable to be rashly assumed from the part; when a false appearance of truth may be mistaken for explanation; when the result of an erroneous observation, unchecked by scientific training, may be hastily considered to amount to demonstration. Education can have no more important aim than to equip pupils with the best known method for the recognition of truth. Every day of their lives they will have to decide as to the truth or falsity of some statement; and what is to prevent their going astray, if they have not been practiced in searching out all modifying circumstances of a problem, if they have not been accustomed to finding the balance of evidence, and taught the great lesson that judgment is not to be given rashly, but must be suspended when sufficient data to warrant a decision are not obtainable? The old studies of our schools do nothing toward training the young in examining evidence and forming judgments. The study of science, however, when rightly conducted, mainly consists of the process of investigation, the very instrument which pupils must be able to use handily in after life to save themselves from becoming the victims of impostors and swindlers. Aside from the material advantages involved, the habit of making truth the goal of his exertions inspires in the young learner a respect and fondness for truth for its own sake which can not fail to have an elevating influence on his character. Science should have, therefore, an important place in every school programme; it should be introduced in the lowest grades, in order to give the child's unfolding faculties the proper bent; and it should be continued throughout the school course in order to save the half-formed habit of intelligent inquiry from being lost by an interruption of its exercise. Our children could well afford to grow up in ignorance of the height of Mount Chuquibamba and the length of the Brahmapootra; they might dispense with a smattering of French, or do without the Latin declensions and conjugations, if the time thus saved enabled them to gain some facility in sift-ing truth from falsehood. An encouraging improvement in our educational ideas has been shown of late, and it seems as if the time could not be far distant when all who have any voice in the training of the young will see clearly what knowledge and what acquirements are of most worth.

LITERARY NOTICES.

Individualism, a System of Politics. By Wordsworth Donisthorpe, Barrister-at-Law, author of "Principles of Plutology," etc. London and New York: Macmillan & Co. Pp. 393. Price, $4.

This is a work which we feel justified, after a careful perusal, in commending to the study of our readers. The questions which it discusses are of the first importance, and Mr. Donisthorpe gives one the impression of a man thoroughly familiar with his own ground, and whose conclusions have not been formed at hap-hazard or without deep and earnest reflection. The main idea of the book is that individualism properly understood furnishes the key to a true political system. The last thing Mr. Donisthorpe would wish to do would be to relax the bonds of society. His aim, on the contrary, is to strengthen and perfect society, in the first place, by a scientific separation of the domain of the state and that of private activity; and, secondly, by carrying to its fullest legitimate development the principle of individual liberty. He has not, perhaps, developed his thesis in the most coherent manner possible; we think the work might be rearranged and perhaps somewhat compressed, with advantage to the main argument; but meantime we are glad to recognize in it a powerful and timely plea for principles of government with which "The Popular Science Monthly" has always been distinctly in sympathy. Mr. Donisthorpe writes as a lawyer; and the influence of his juristic studies is visible on every page. At times his argument gains in force through the dispassionate practicality of the legal mind; and at times it assumes a character somewhat too forensic for the best general effect.

In Chapter I we have a discussion of the growth and evolution of the state. There is nothing here distinctly novel. As regards the origin of political government the author accepts the ideas of Mr. Spencer, and refers also with approval to "the learned and fascinating works of the late Sir Henry Maine." He develops well, however, the idea that the tendency of modern times has been toward the forming of larger and larger political aggregates; and that in the present day the facilities for communication and transport which science has made available have increased more wonderfully than ever the possibilities of state growth. Apparently Mr. Donisthorpe's ideal is one center of law—so far as law is an absolute necessity—and the widest possible individual liberty throughout the whole community. He is not a friend to what is called "local option"; he considers that it means little else than local tyranny, and perhaps he is right. He does not believe in cutting up a country into larger and smaller geographical squares, and making the conditions of life for each man depend on the particular square in which he chances to live. He holds that the same (legal) conditions of life should be available for all members of the community, and that these should be of the simplest character possible. "Imperial law," he says, "must henceforth be based on individual and local liberty."

Chapter II deals with "The Structure of the State." The author announces himself a thorough-going democrat, and ventures to lay down the principles to which a true democratic government must conform. We must refer to the book itself, however, for his definition and defense of democracy, including the principle, unreservedly accepted, of universal suffrage. One remark here is worth quoting: "Majorities for their own sakes would do well not to bring minorities to bay. The result may be either painful or humiliating—painful, as when the minority (in heads, in riches, and in organization) withstood the tyranny of the Stuarts; humiliating, as when England bowed down before the determined Boers of the Transvaal. It is not wise to threaten what you do not mean to perform. Minorities mean action; majorities as a rule do not."

In Chapter III, on "The Functions of the State," we have, in the first place, a *résumé* of the functions commonly assigned to modern governments; and, secondly, a criticism of the tendency, just at present in the ascendant, of looking to legislation for the cure of all ills and the securing of all benefits. "The spirit of the individualist movement," the author tells us, "is one of resistance to any overstepping by the legislature of its normal boundaries. It is the embodiment of the absolute principle of civil liberty, or the greatest possible liberty of each compatible with the equal liberty of all." We need hardly observe that this is sound Spencerian doctrine. Later on in the volume the author has a good deal to say in criticism of Mr. Spencer's "Man *vs.* the State"; but this does not prevent his recognizing Mr. Spencer, on the first page of his preface, as the man "who has contributed more to the scientific study of society than any other thinker—not even excepting Auguste Comte or John Austin"; and as the one to whom the merit belongs "of formulating this (the individualistic) theory of government, and thus of laying the rough foundation on which a sound art of politics may be based." Mr. Donisthorpe laments the fact that in England to-day "the Conservative party have thrown in their lot with state socialism," and are now playing with the Liberals a game of grab for the votes of those whom a Socialistic programme attracts. He shows reasons, however, for holding that the present tendency is rather an eddy in the general current, than a main movement likely to be continued in the future—a reaction toward unintelligent political methods due to the recent inclusion (he is speaking of England) of lower layers of the population in the electorate.

We pass over Chapters IV and V, entitled "What is Property?" and "What is Capital?" which do not seem to us to have a very direct bearing on the main purpose of the book; while the style in which they are written is somewhat tiresomely disputatious. The chapters on "The Labor Question" and "The Capitalization of Labor," which immediately follow, are, on the other hand, full of interest. In the first of these the author describes with great force the present economic condition of the laboring classes. He accepts without reserve the Ricardian doctrine of the tendency of wages to a minimum, maintaining that it has been so irresistibly proved *a priori* that to discuss it in the light of any partial facts or observations is the merest waste of time. He pours unmeasured ridicule on the newfangled doctrine of "the standard of comfort" by which some political economists try to make the Ricardian law appear less cruel in its operation. "Wagedom," says Mr. Donisthorpe, is only a shade better than serfdom, and is virtually a kind of serfdom. The remedy for it, however, does not lie in socialism, which would only aggravate all the ills of society, but in the substitution for the wage system of what Mr. Donisthorpe calls "the capitalization of labor." His idea is briefly this: The wage-earner at present takes, when he can get it, a certain average wage from his employer, the amount of which does not depend upon the profitableness or otherwise to his employer of the business carried on. In other words, the employer insures the laborer a certain wage independently of the fortunes of his business. Now, nobody insures another without charging something for it; and the capitalist class recoup themselves for insuring a certain average wage to their employés *by putting that average wage somewhat, perhaps considerably, below what their average profits would justify.* By the capitalization of labor Mr. Donisthorpe means treating labor as capital (which he contends it is), and establishing a partnership between it and capital—a true partnership, in which gains and losses would be shared. Mr. Donisthorpe shows how a beginning might be made by taking the average wages in one or more lines of business for a certain number of years, and fixing the proportion which these had borne to average profits during the same period. The laborers might then approach the capitalists and say: These are the wages you have been able to pay us on the principle of insuring us a fixed compensation whether your business prospered or not. Now, we wish to throw our labor as so much capital into your business, on the understanding that, if your profits are greater than the average profits of the period we have been considering, you will pay us in proportion, and that, if they are less, you will pay us in proportion also.

We must refer those of our readers who wish to see how much can be urged on behalf of the plan proposed, to Mr. Donisthorpe's book, merely observing that, in point of practical suggestiveness, we consider the two chapters last mentioned worth a score of such books as "Looking Backward." We do not say that every difficulty has been fully met; but we do say that Mr. Donisthorpe has propounded a scheme which is not necessarily Utopian, and which seems to contain great promise of good. Surely, on the face of it, it is evident that society must some day discover some better principle than that according to which the laborer of to-day professedly gives the least amount of work for the largest amount obtainable in wages, and the capitalist the smallest amount in wages for the largest amount obtainable of work. Such a principle means war, means waste, means wide-spread social demoralization; and it must, if society is to endure, be succeeded at no distant day by some true principle of accommodation and harmony, in virtue of which it shall become the interest of the laboring classes to promote the creation of wealth by faithful and intelligent work, and the interest of the capitalist class to extend the fullest measure of justice to those whose labor fructifies their capital.

The closing chapter of the book contains a most effective criticism of socialism in reply to a Mr. J. L. Joynes, who, if we remember rightly, was a co-laborer with Mr. Henry George in England. It is satisfactory, in these days of crude theories and doleful vaticinations, to meet with a book written in as sober and withal as cheerful and hopeful a spirit as this of Mr. Donisthorpe's. We wish very much that the more helpful portions of it could be presented to the public in briefer and more popular form; but, as it is, we trust that the book, as a whole, will be read and pondered by all who are interested in social problems.

Introduction to the Study of Philosophy. By William T. Harris. Comprising Passages from his Writings, selected and arranged, with Commentary and Illustration, by Marietta Kies. New York: D. Appleton & Co. Pp. 287. Price, $1.50.

This compilation has been made in order to adapt for class use the teachings contained in the miscellaneous philosophical works and articles of Dr. Harris. Many of the passages have been taken from the "Journal of Speculative Philosophy," others from the editor's prefaces to volumes in the "International Education Series," from Dr. Harris's lectures at the Concord School of Philosophy, and from his articles in various educational journals. The illustrations supplied by Miss Kies are such as she has used with her classes of girls at Mount Holyoke Seminary. The opening chapters deal with "Methods of Study," the "Presuppositions of Experience," and the "Philosophy of Nature." The rest of the volume deals with man as a self-active individual, taking up in successive sections sense-perception, representation, reflection, the syllogism, the absolute idea or the reason, the emotions, and the will. The concluding chapter discusses the immortality of man. "Philosophy as presented by Dr. Harris," says Miss Kies in her preface, "gives to the student an interpretation and explanation of the phases of existence which render even the ordinary affairs of life in accordance with reason; and, for the higher or spiritual phases of life, his interpretations have the power of a great illumination."

Problems of the Future, and Essays. By S. Laing. London: Chapman & Hall. Pp. 409. Price, 3*s.* 6*d.*

It is characteristic of man to take pleasure in measuring his strength against obstacles. In the youth of the individual or the race, he delights in athletic contests; in the prime of life, he enjoys the struggle to obtain subsistence and comforts for his family, and the rewards of social eminence; and at a more advanced period the study and more or less perfect solution of intellectual problems afford him satisfaction. The world, or at any rate the Anglo-Saxon race, may be said to have reached its maturity, and intellectual problems are exciting our interest and engaging our powers as never before. There have been a few philosophers in every age since the beginning of history, but scientific, social, and religious questions are now occupying the minds of many who do not claim to be philosophers. "There is a large and, I believe, rapidly increasing class," says Mr. Laing in his introduction, "who have already acquired some elementary ideas about science, and who desire to know more. Curiosity and culture are in effect convertible terms: the wish to know is the first condition of knowing. To many who are in this stage of culture, but who have neither the time nor faculty for following up closely the ever-widening circle of advanced thought, it may be interesting to get some general and popular idea of some of the unsolved problems which have been raised by modern science, and are occupying the thoughts of the men who lead its van." To meet the want defined in this passage is the object of the present volume. The questions which the author discusses in his earlier chapters relate to the past history of the earth and other cosmic bodies. These are, How long has the sun been giving out heat enough to sustain life on the earth? What is the universe made of? What has been the climate of the earth in geologic times? When was the Glacial period, and how long did it last? From these topics he passes to the consideration of the antiquity of man and the method of his origin. A chapter is devoted to "Animal Magnetism and Spiritualism"; several religious questions are then taken up; and, finally, certain economic problems are considered. The religious questions are, whether agnosticism is reconcilable with Christianity; how great a historical element there is in the Gospels; and whether the skepticism of the present day justifies pessimism. "The Creeds of Great Poets" are also passed in review. First of the political and economic essays is an analysis of the reasons for the tension which keeps Europe constantly armed; the others deal with the financial problems of England, and the increase of population with reference to the food-supply of the world. In the case of each problem which he raises, Mr. Laing makes evident what solution he deems most probable. His discussions show a thorough knowledge of and sympathy with the scientific enlightenment of the times; and, in regard to those questions which man *must* answer in the future, he is generally confident that science will be able to give a beneficent solution. The only exception is in regard to the food problem, where he can see relief only from a diminished birth-rate or an increased death-rate, and the idea of discovering new ways of producing edible products is not mentioned.

TIMBER AND SOME OF ITS DISEASES. By H. MARSHALL WARD. London and New York: Macmillan & Co. Pp. 295. Price, $1.75.

THIS work originated in a series of short articles in "Nature," and forms one of the Messrs. Macmillan's "Nature Series." It is intended as a popular scientific rather than an exhaustive and technical account of its subject. The opening chapters deal with the general character and structure and the properties and varieties of timbers; also with the classification of timbers based on these properties. An extended review of the theories about the ascent of water in tall trees is given, the conclusion of the author being that of the imbibition theory of Sachs and the osmosis-gas-pressure theory of Hartig and Godlewski and others, the latter is the more probable. While he admits that the rhythmical character of the respiration of protoplasm, on which the osmosis-pressure theory depends, is not proved, he maintains that recent researches are in favor of Godlewski's views as to the behavior of the protoplasm. The next three chapters deal with the dry-rot and other diseases of timber caused by various fungi, figures of which are given. The structure of the bark of trees, and the process of healing wounds by occlusion, are then described, with illustrations. Returning to diseases, the author describes "canker," or the larch disease, leaf diseases, and pine blister. The final chapter deals with the "damping off" of seedling trees.

INSTITUTES OF ECONOMICS. By E. B. ANDREWS, D. D., LL. D., President of Brown University. Boston: Silver, Burdett & Co. Pp. 227. Price, $1.30.

THE most conspicuous feature of this book is the thoroughness with which its contents has been analyzed, classified, and annotated. It is introduced by a chapter defining the field of economics and stating the nature of the chief schools of economists. The body of the work is divided into six parts, devoted respectively to production, exchange, money and credit, distribution, consumption, and "practical topics involving economic theory," which last includes chapters on coin and paper currency in the United States, taxation, and poverty. It is an elementary text-book, intended for classes in colleges and, with perhaps the omission of the most difficult sections, for high-school and academy classes. Its point of view is historical, though it maintains the existence of general economic laws, absolutely and universally valid. Its sundering of economics from ethics, jurisprudence, and sociology in general is less arbitrary than in most treatises. It makes wealth, not exchange, the central conception of the science, and recognizes immaterial wealth as well as material. On the difficult topic of value, the fresh analyses of Böhm-Bawerk and Menger are heeded and in part followed. The leading ideas are distinguished by heavy type, and each section is accompanied by a list of references bearing upon its subject-matter, and by copious notes. The volume lacks an index.

Eclectic Physical Geography. By Russell Hinman. Cincinnati: Van Antwerp, Bragg & Co. Pp. 382. 12mo.

Since physical geography includes parts of nearly all branches of science, and its study precedes that of the sciences in many schools, an introductory chapter has been prefixed to this book, in which the chief properties of matter and of heat, light, magnetism, and electricity are set forth. The topics forming the body of the book are arranged in a logical order, putting first the relations of the earth to the other members of the solar system. After this difficult subject has been disposed of, the atmosphere is considered, for the reasons that it forms the outer envelope of the earth, and that its action is the proximate cause of all details in the relief of the land and of the more conspicuous phenomena of the sea. Next come descriptions of, first, the sea, and then the land. The subject of climate follows these, and the concluding chapters deal with life, from yeast up to man. The details concerning the various topics are put in small type. The text is illustrated by one hundred and fifty cuts and many maps.

A Lenâpé-English Dictionary. Edited by Daniel G. Brinton, M. D., and Rev. Albert Seqaqkind Anthony. Philadelphia: The Historical Society of Pennsylvania. Pp. 236. Price, $3.

This vocabulary is based upon an anonymous manuscript in the archives of the Moravian church at Bethlehem, Pa., supposed to have been compiled by the Rev. C. F. Dencke, and containing about three thousand seven hundred words. The manuscript was carefully examined by the Rev. A. S. Anthony, who is a born Lenâpé, after which he and Mr. Brinton together passed in review every word in the dictionary. No attempt has been made to increase the lexicography by the insertion of words or forms obtained from the Delaware language of to-day. The editors have confined their efforts to presenting this work as exclusively concerned with the dialect as employed by the Moravian missionaries; and hence all additions to the vocabulary have been from their writings. A full index enables the equivalent of any English word to be found in the dictionary, if it is therein. The volume is printed on rough, heavy paper, with untrimmed edges. It is the first of "The Penn'a Students' Series," a series of volumes to contain material of interest to the students of Pennsylvanian history. Copies may be procured from the Librarian of the Historical Society, 1300 Locust Street, Philadelphia.

The Industrial Progress of the Nation. By Edward Atkinson, LL. D., Ph. D. New York: G. P. Putnam's Sons. Pp. 395. Price, $2.50.

Under the above title Mr. Atkinson has combined two series of magazine articles dealing with economic subjects, together with two or three addresses not before published. The statements and inferences presented in this volume are based on the author's extended study of the national accounts and the statistics of international commerce. In the paper which stands first, the idea is presented that "while the power of mankind to consume the products of the earth is limited, the source from which man may draw satisfaction for his material wants is practically unlimited." A special part of the subject of production and consumption, namely, the food question in America and Europe, is treated in the next essay, and a host of facts and figures are given bearing on the existence of waste and want side by side. In the two articles on "The Relative Strength and Weakness of Nations," the strength of democracy, as shown in America, and the weakness of nations which are governed by monarchs, are analyzed. Following these is a series of papers dealing with the distribution of the products of industry, and as connected with this subject the author discusses in another essay the question "What shall be taxed?" The general conclusions to which this series of inquiries leads him are, that the working classes are obtaining a constantly increasing and the capitalists a constantly diminishing share of an increasing product; that the share which any person may secure depends upon his use of his own abilities; and that all laws restricting the free use of time and talent are inconsistent with progress. In the latter portion of the volume are papers on "Slow-burning Construction" (illustrated); "The Missing Science" (in which an economical method and apparatus for cooking are described); "A Single Tax on Land"; and "Religion and Life." The discussions in this volume are characterized by thoroughness of study, and an earnest desire to spread enlightenment on these important subjects.

A third hand-book of pronunciation has been published by *William H. P. Phyfe*, entitled *Seven Thousand Words often Mispronounced* (Putnam, $1.25). It is intended to include all the English words and names and the foreign words liable to be mispronounced by an English-speaking person. The words are all arranged in one alphabetical list, the names only beginning with capitals. Pronunciation is indicated by respelling in full, and in some cases how the word is *not* sounded is also indicated, and other explanatory notes are inserted. Where several important pronunciations of a word occur, the fact is indicated, Webster's pronunciation being generally placed first. Prefixed to the list are a chapter on the sounds of the English language, suggestions on the use of the book, and a key of diacritical marks. The author enumerates forty-two sounds in English, although the American Philological Association recognizes only forty—the two additional ones being obtained by distinguishing the vowel in *serge* from that in *urge*, and the one in *dog* from that in *odd*. Two instances of carelessness are, that the author names as one of his authorities "Worcester's Unabridged Dictionary," meaning "Worcester's Quarto Dictionary," and the only pronunciation of *Algonquin* given in the Supplement to Webster is ignored. The volume is printed in clear type on fine paper.

We have received of what might be styled calendar publications of the Smithsonian Institution, Mr. *G. H. Boehmer's* Report on *Exchanges* for the year ending June 30, 1887, and nine *Accounts of Progress* in as many branches of investigation in the year 1886. In the first of these publications, Mr. Boehmer, after relating the year's transactions in his office, reiterates the recommendation that has been made in previous reports, for the designation of a permanent agency abroad to give personal attention to the business of exchanges. His opinion that otherwise only temporary results can be obtained is confirmed by his own experiences.—In his *Account of the Progress of North American Geology* for 1886, Mr. *Nelson H. Darton* has sought to include abstracts, without bias or partiality, of all important publications distributed during the year. It is unfortunate, and hardly in keeping with the character of an institution like the Smithsonian — especially when three years are taken for the printing—that hurried preparation is offered as a reason for imperfections, and limitations of space for omitting the bibliography, which is to be made a bulletin of the Geological Survey. Mr. *C. G. Rockwood, Jr.*, arranges his *Account of Progress of Vulcanology and Seismology* under the heads, as heretofore, of Vulcanology—including volcanic phenomena of 1886, volcanic phenomena of previous years, and causes of volcanic action; Seismology — earthquakes of 1886, earthquake lists of 1885; catalogues of earthquakes of previous years, and study of earthquakes; and Seismometry—instrumental records and instruments. A bibliography of eight pages is appended.—Mr. *John Belknap Marcou* furnishes to the series a *Bibliography of North American Paleontology*, giving the titles of works in the order of the authors' names, alphabetically, and descriptions or analyses of the contents of the more elaborate ones, in some instances of considerable fullness.—The *Account of Geography and Exploration*, by *William Libbey, Jr.*, comprises extremely brief accounts, by continents, of the principal explorations of the year, their purposes and facts. In the *Account of Progress in Physics*, Prof. *George F. Barker* gives lucid analyses of the principal papers presented, with results [illegible] or suggested on the general subject and in mechanics, heat, light, and electricity. A necrology and bibliography supplement the text.—Prof. *H. Carrington Bolton*, in the *Account of Progress in Chemistry*, gives similarly clear notices of papers, discoveries, and experiments in chemistry, with necrology and bibliography.—The *Progress of Mineralogy* is described by *Edward S. Dana* under the heads of "General Works" on the subject, "Crystallography and Physical Mineralogy," "Chemical Mineralogy," "New Mineral Occurrences in the United States and Elsewhere," and "New Minerals." The bibliography includes brief references to papers upon mineral species.—As characteristic of *Progress in Zoölogy*, Mr. *Theodore Gill* observes that more and more attention is being paid to histology and embryology, perhaps at an undue expense to sytematic zoölogy, and regrets the tendency as hurtful to the welfare of the science, but hopes that in due time it will be corrected. The subject is reviewed in the order of zoölogical classification, and a necrology is supplied.—In the account of *Progress of Anthropology*, Prof. *Otis T. Mason* draws attention to comprehensive summaries, courses of lectures, and descriptions of instrumentalities. The heads are, "Archæology," "Biology," "Psychology," "Ethnology," "Comparative Philology," and "Mythology and Folk Lore." Clear ideas of the principal papers are given in the abstracts. A bibliography is added.

Mr. *Otis T. Mason* gives in the papers of the United States National Museum a valuable contribution to anthropology in the shape of an illustrated paper on the *Cradles of the American Aborigines*. The author finds that in both Americas the majority of aboriginal children are confined in a sort of cradle from their birth till they are able to walk about. During this period the cradle serves many purposes—as a mere nest for the helpless infant, as a bed so constructed and manipulated as to permit sleep in either a vertical or horizontal position, as a vehicle for carrying the child suspended on the mother's back or from the saddle-bow, as, indeed, a cradle to be hung on the limbs of trees to rock, as a playhouse and baby-jumper, and as a kind of training school whence the child emerges little by little till it leaves it altogether. These various uses are exhibited in the accounts which follow of the cradle systems of the different tribes. Methods of strapping the limbs and treating the head and their effects on the form, also enter into consideration.—Mr. *Walter Hough's* paper *On the Preservation of Museum Specimens from Insects and the Effects of Dampness* considers the virtues and defects of various poisonous preparations, and supplies directions for accomplishing the objects implied in the title.—*Ethno-Conchology: A Study of Primitive Money*, by *Robert E. C. Stearns*, describes the many kinds of shells that have been applied by primitive people in all parts of the world to the purposes of a currency, the methods of preparing and using them, more particularly the wampum belts of our Eastern Indians, and the shell money of the Pacific coast. The text is illustrated by nine plates and many inserted cuts, and some dozen other papers are cited in the bibliography.—Dr. *J. H. Porter's Notes on the Artificial Deformation of Children among Savages and Civilized Peoples* is also published in connection with Prof. Mason's *Cradles*, to which it bears a close relation, as it is in the cradles that the deformations are started. The subject is considered by Dr. Porter from a broad philosophical point of view, without much reference to special methods of deformation. These are mentioned in a summary of "General Notes on Deformition," which is at the same time a bibliography.—Prof. *Mason's The Human Beast of Burden* is of a piece in value and interest with his paper on "Cradles." The author is set by the sight of an express train to reflecting on the long and tiresome experiences through which the human mind has passed upward to that climax of invention. At the lower end of this line "we come at last to the primitive common carrier, the pack-man himself, and also the pack-woman, for men and women were the first beasts of burden." This person, with his load and his method of attaching and managing it, are considered under the aspects they present or have presented in different countries and ages; and the whole is made plain by means of pertinent illustrations.

Further contributions by Dr. *R. W. Shufeldt* to the study of the bone-structures of birds include *Observations upon the Osteology of the Order Tubinares and Stegano-*

podes, or albatrosses, fulmars, shearwaters, petrels, gannets, cormorants, pelicans, etc.; similar *Studies of the Sub-family Ardeinæ*, of which the great blue heron, *Ardea herodias*, is selected as the type; and, under the heading of *Contributions to the Comparative Osteology of Arctic and Sub-arctic Water-Birds*, a memoir on "The Auklets."

The number of *The American Journal of Psychology* (E. C. Sanford, Worcester, Mass., $5 a year) which completes its second year contains three principal articles. The first of these is by Charles L. Edwards, on the "Folk-lore of the Bahama Negroes," and embodies many stories similar in character to those which have been recently obtained from the negroes of our Southern States. The collection is introduced by several pages of description of the islands and the people. The second paper is "On some Characteristics of Symbolic Logic," by Christine L. Franklin. The fourth and concluding paper of Dr. W. H. Burnham's series on "Memory, historically and experimentally considered," appears in this number. In this paper Dr. Burnham sketches the progress of recent theories. He finds that the view that "the essence of memory is a functional disposition persisting in the brain is, perhaps, the one most widely held by contemporary psychologists." He also glances at the recent experimental studies upon memory, and appends to his paper a bibliography of the most important literature of the subject.

In *The Chemistry of Narcotics*, a pamphlet by Prof. *E. Haworth* (the author, Oskaloosa, Iowa, 25 cents), a brief account is given of the preparation and chemical character of the common alcoholic beverages, chloral, the bromides, and the vegetable alkaloids. A table of percentages of alcohol in foreign and domestic alcoholic beverages is appended.

The Cosmic Law of Thermal Repulsion (Wiley, 75 cents) is an attempt to account for the tails of comets. The author's view is, that the projected matter forming the tail has been separated from the body of the comet by the radiant energy of the sun. He states the details of his hypothesis in the present essay, and quotes from many scientific authorities passages which directly or indirectly support it.

The popular lectures and discussions given before the Brooklyn Ethical Association last winter have been published in book-form under the title *Evolution* (James H. West, Boston). The fifteen papers on various evolutionary topics which the volume comprises were noticed in these pages when published separately.

A paper on *Marine Shells and Fragments of Shells in the Till near Boston*, by Prof. *Warren Upham*, has been published in the Proceedings of the Boston Society of Natural History, Vol. XXIV. The fossils here described have been before regarded as evidence that the land in which they are found had been previously submerged beneath the sea. Instead of this, the observations of Prof. Upham go to show that the fossils were brought to their present positions from the bed of the sea on the north, by the ice-sheet. In the same volume is a paper on *The Structure of Drumlins*, also by Prof. *Upham*. Another recent paper by him, on *Glaciation of Mountains in New England and New York*, is published in "Appalachia," Vol. V, No. IV.

In a bulletin on *Natural Gas in Minnesota*, the geologist of that State, Prof. *N. H. Winchell*, reviews the geological facts and the results of experiments bearing on the question whether gas in any considerable quantity is likely to be found in Minnesota. His conclusions are, that the great formations that furnish gas in the United States are almost wholly wanting in Minnesota; that the gas which comes from shallow wells at Freeborn is confined to the drift; and that if gas is found in Minnesota in a lower formation than it has been found in anywhere else, as has been predicted, it will be something new in geology.

The publication of a treatise on the *Paleontology of the Cretaceous Formations of Texas* has been undertaken by Prof. *Robert T. Hill*, of the University of Texas, at Austin. It is to be published in installments, at twenty-five cents each. Part I, now issued, comprises descriptions of three specimens, with plates. The same author has also published Part I of a *Check-List of the Invertebrate Fossils from the Cretaceous Formations of Texas, accompanied by Notes on their Geographic and Geologic Distribution.* In "Th

American Journal of Science" has appeared recently a paper by him on the *Relation of the Uppermost Cretaceous Beds of the Eastern and Southern United States*, and in "The American Geologist" another on *The Foraminiferal Origin of Certain Cretaceous Limestones and the Sequence of Sediments in North American Cretaceous.*

The little *Hand-Book of Precious Stones*, by *M D. Rothschild* (Putnam, $1), gives a brief sketch of the properties of each mineral used in jewelry. The specific descriptions are introduced by directions for recognizing and determining the characters by which the quality of precious stones is ascertained. A table of hardness and specific gravity is appended.

Three memoirs on *Meteoric Iron*, by *George F. Kunz*, relate respectively to a mass weighing 15½ ounces, which was found on Linnville Mountain, N. C., about 1882; a mass of 25·61 pounds weight, which was found in Laramie County, Wyoming, in January, 1887; and the Johnson County (Arkansas) mass, which fell in 1886, and is noteworthy as having been the largest mass ever actually seen to fall. It weighed 107½ pounds. Physical descriptions, chemical analyses, and photographic illustrations of the stones are given. Another paper by Mr. Kunz includes "Mineralogical Notes" on "Phenacite from Maine," "Quartz Pseudomorphs after Spodumene," "A Remarkable Variety of Transparent Oligoclase," "Apatite from near Yonkers, N. Y., "Cyanite from North Carolina," and an "Aragonite Pseudomorph."

A valuable contribution to the study of the structure of the crinoids is given in a paper entitled *Discovery of the Ventral Structure of Taxocrinus and Haplocrinus, and Consequent Modifications in the Classification of the Crinoidea*, by *Charles Wachsmuth*, of Burlington, Iowa, and *Frank Springer*, of Las Vegas, N. M. The descriptions are supplemented by excellent plate illustrations.

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POPULAR MISCELLANY.

The Future of our Weather Service.—Everybody has been noticing that more and more of our official weather predictions turn out wrong, and in the hope of restoring their former efficiency several bills have been introduced into Congress within the last few years for transferring the Weather Service from the War Department to a civil bureau. The reasons for such a change, as stated in a pamphlet sent to us by Mr. H. H. Clayton, are that military regulations hamper the scientific work of the bureau, and cause civilians, who have joined the service from aptitude for science, to resign. The abler military men, also, seeing no hope of promotion in the Signal Corps, generally prefer the line. The natural result has been that, as General Greely reports, the service is full of incompetents, and the percentage of successful weather predictions has decreased in the last five or six years from eighty-seven to seventy-six per cent. During the same time the weather service in European countries has been steadily gaining in efficiency. The objections to the transfer are: First, that military control is claimed to secure superior promptness, accuracy, and continuity of record, which is met by the statement that the European weather services are entirely civilian, and our own depends for some of its data upon observations telegraphed by civilian observers from about twenty stations in Canada. Second, it is claimed that only military discipline could keep men in disagreeable or dangerous places; but civilian observers are found to man the Canadian meteorological outposts in Manitoba, and the mountain-peak stations in Europe. Third, it has been urged that the cost of the weather service would be increased by civilian control; but our military weather service costs more than the civilian services of all the governments of Europe put together. The appropriations are now about $900,000 a year, and some considerable reduction that has been made in the cost during the last few years has been due to the employment of civilian aid. Fourth, it has been urged that the military training of the observers would be of value in case of war; but if this argument is valid, the postal service and all the other Government departments should be put under military control. A fifth objection is, that in a civil bureau the appointments would be controlled by political influence. But with the protection of the civil service rules, it is probable that the bureau would be at least as free from favoritism as the army is. It has also been objected that the Government would be breaking its contract with the men of the Signal Corps if they were transferred to a civil bureau. But this difficulty could be met by allowing the military men now in the bureau to choose whether they would go with the Weather Service or stay with the Signal Corps. The chief signal officer is even better aware of the defects of the Weather Service than any outside critic. But the remedy which General Greely proposes is to replace the second lieutenants in the Weather Service by officers of higher rank, and that future vacancies in the lowest rank of commissioned officers in the service shall be filled by transfer from the line of the army. This latter provision, by taking away hope of promotion from the sergeants and privates, would deter able men from entering the lower grades, and gaining the experience necessary for filling the higher positions. Moreover, the Weather Service has so absorbed the Signal Corps that the major-general in command of the army is now urging the formation of a special Signal Corps for actual army purposes. Both these schemes would involve additional expense, but the transfer of the Weather Service to, say, the Department of Agriculture, would secure the same ends by leaving the present Signal Corps free for signaling service, and allowing the meteorological work to be put in charge of scientific men instead of soldiers, while the cost of the work would be lessened instead of increased.

Open-air Travel for Consumption.—Dr. Henry L. Bowditch has given the Climatological Association an account of the treatment which seems to have counteracted a strong tendency to consumption in his own family. In 1808 his father, then thirty-five years old, was undoubtedly threatened with consumption. On August 29th of that year, when thus ill, he started from Salem, Mass., with a friend as his companion and driver, in an open one-horse chaise, for a tour through New England. The trip lasted thirty days and covered 748 miles. During that time he passed from the deepest mental discouragement and physical weakness through all stages of feeling up to a real enjoyment of life. His journey, though benefiting him immensely, probably did not wholly cure him, but it proved to him the absolute need he had of regular, daily, physical, open-air exercise. Afterward, under walks of one and a half to two miles, taken three times daily, all pulmonary troubles disappeared. He died, thirty years after the journey, from carcinoma of the stomach, his lungs being normal except that one presented evidences of an ancient cicatrix at its apex. He prescribed for his children the same regular out-of-door exercise which had been so beneficial to him. As soon as they were old enough they were required to take daily morning walks of about a mile and a half. If at any time they were observed to be drooping, they were taken from school and sent into the country to have farm-life and out-of-door play to their hearts' content. In consequence of this early instruction, all his descendants have become thoroughly impressed with the advantages of daily walking, of summer vacations in the country, and of camping out, etc., among the mountains. Dr. Bowditch's father had married his cousin, who, after long invalidism, died of chronic phthisis in 1834. Certainly a consanguineous union of two consumptives foreboded nothing but evil. Yet, of their eight children, six are either now alive or they arrived at adult age, married, and have had children and grandchildren, but not a trace of phthisis has appeared in any of these ninety-three persons. Dr. Bowditch sees nothing but the influence of out-of-door life to which this immunity of his family from consumption can be attributed. He has prescribed it, under proper precautions, in his practice for years, and says, in conclusion: "I have no objection to drugs, properly chosen, and I almost always administer them; but if the choice were given me to stay in the house and use medicines, or to live constantly in the open air without them, I should infinitely prefer the latter course in case of my being threatened with pulmonary consumption."

Precious Stones in the United States.—Mr. George F. Kunz's report on precious stones to the United States Geological Survey's Division of Mining Statistics shows that the industries of our country in that line, though not very extensive, are more considerably developed than they are generally known to be. The principal localities where gems are sought for systematically are at Mount Mica, Paris, Me., and Stony Point, N. C. Considerable quantities of tourmaline and other gems are produced at Mount Apatite, Auburn, Me. Several localities in North and South Carolina and Kentucky have been opened and are worked for the production of zircon and several other comparatively rare minerals which have been looked on heretofore only as gems, but are now used for making the oxides of zirconium, lanthanum, cæsium, etc., to be employed for manufacturing purposes. A considerable number of cases of exceptional discoveries of gems of rare value are recorded, but they are so scattered as not to admit of grouping either by kind or place. Among the notable collections of gems in the United States mentioned by the author, are the three hundred and thirty-one antique gems of the late Rev. C. W. King, of England, which have been presented to the Metropolitan Museum of Art; Mr. Maxville Somerville's collection of fifteen hundred specimens of antique jewel-carving art, now on loan in the Metropolitan Museum; the Rev. Dr. W. Hayes Ward's three hundred ancient Babylonian, Persian, and other cylinders, now the property of the museum; the gem collection bequeathed by Dr. Isaac Lea to his daughter; and the series of precious stones, including about one thousand specimens, which, though not expensive, are the finest in the United States from an educational point of view, belonging to the National Museum. Mr. Kunz also gives some interesting fashion-notes about precious stones. They fluctuate in favor. Amethysts and cameos, much sought for ten years ago, are now thrown out. Rubies, already very high, are all the time rising. Topaz is not in demand. Coral is going out, while the popularity of amber is increasing. The use of Brazilian pebbles has decupled since 1878. The rare stones known as "fancy stones," which were formerly kept only as specimens, are now looked upon as articles of trade, and as part of the normal jeweler's stock. Mr. Kunz, as agent of Tiffany & Co., had a fine collection of North American precious and ornamental stones at the Paris Exposition, of which we have published a laudatory notice by "La Nature." It included three hundred and eighty-two specimens.

Botany as a Disciplinary Study.—Botany is recommended as a disciplinary study by Mr. Gerald McCarthy. It is much in its favor that the objects with which it deals are convenient of access and full of interest. Among the other advantages that it offers are the adaptation of the study of plants to the cultivation of the æsthetic faculties; to training the mind to habits of close observation and discriminating judgment, orderly arrangement, and the "logic of systemization"; its presenting the phenomena of life in its least complicated manifestations; plants offering better opportunities for thorough study than is practicable with minerals and animals; the usefulness of the study as a recreation and mental tonic; and the inexhaustible field for research which it offers. If some object that the technical names are hard, "at the beginning it will serve just as well to use the common vernacular name, or even invent names for one's self. The name is the least important thing one can learn about a plant, and it is not wise for the beginner to exhaust his time and patience in trying to choose the most proper of several possible and equally unintelligible names. Rather he should seek to group the specimens around common types, thus learning for himself the philosophy of the natural system." But the scientific name must eventually be learned, and it will come easier after the student has observed well for himself. For young pupils, and older ones who are unfamiliar with Latin, Miss Youmans's "First Book in Botany" is recommended as the best manual to begin with. It will lead up to the more advanced works. But more useful than any book is the student's field outfit, of lenses and knives, needles and trowel, and air-tight specimen-box.

Causes of Unhealthiness in Large Cities.—The mere age of London, said Dr. G. V. Poor, in a lecture at the Sanitary Institute, was one of the reasons why it became unwholesome. Roman London was buried deeply among rubbish of all kinds, much of which was putrescible, and therefore a source of danger in the soil. Ancient London was well placed and magnificently supplied with water through the Thames and many smaller streams. All the smaller streams had become disgracefully foul, "and for very shame had been covered over." That mediæval London was very unhealthy, a perfect fever-den, there could be no doubt. The causes of the enormous mortality lay in the marshy, undrained soil, fouled with refuse of every kind; in the filthy state of the unpaved city, and a perfectly swinish condition of the houses of the lower orders; in the ill-nourished and drunken condition of the masses; in the state of superstition and brutality which made any measure of public health impracticable; in the bad management in epidemics, and in the incompetence of the medical faculty. There had been a great and manifest improvement in London. This could be credited to the increase of knowledge among the doctors and among the people generally; to vaccination and the modern plan of treating infectious diseases by the prompt separation of the patients; to the cheapness of food, clothing, and fuel, and the facility of obtaining fresh fruit and vegetables; to improved water-supply; and, although the system of sewage disposal was an undoubted evil, it had removed a great deal of filth from dwellings, and the balance was probably so far in its favor. The outlook in the future was obscured by increased overcrowding; the discharge of sewage into the Thames; and the increasing danger of the pollution of the water-supply by the accumulation of population along the valley of that river.

Clark University.—Clark University, Worcester, Mass., founded by Mr. Jonas G. Clark as an institution for the highest culture, was opened in October, 1889, in the departments of mathematics, physics, chemistry, biology, and psychology, under the presidency of G. Stanley Hall. The president is, for the time being, Professor of Psychology, and, with the assistance of Prof. Sandford, will assist students in the departments under that head by instruction, or by conference and guidance to literature; and will direct the work of special students in the history, methods, and organization of education, elementary, intermediate, and superior, lecturing on them during a part of the year. The professors are H. H. Donaldson in neurology, Edmund C. Sanford in psychology, Warren P. Lombard in physiology, F. Mall in anatomy, Albert A. Nicholson in physics. The methods of instruction include field-work, excursions, "coaching and cram classes," examinations, conferences, laboratory work, and lectures. The students are classified as independent, candidates for the degree of Ph. D., special students not candidates for a degree, medical students, and prelim [illegible] undergraduates. Twenty fellowships and ten scholarships have been provided by Mr. and Mrs. Clark, affording free tuition to thirty persons.

Huron and Iroquois Burials.—In a paper on "Indian Burial in New York," read at the meeting of the American Association, Mr. W. M. Beauchamp said that several modes of burial prevailed in the Huron and Iroquois family at the same time; but at a later date the influence of contact with Europeans and of the custom of adoption was observed. Although the usual position in Indian burial was supposed to be a sitting posture, facing the west, the bodies in a large proportion of the New York graves, while sitting, faced the east. Many burials, both early and recent, were horizontal, and often without deposited articles. For secondary burial, bone-pits were common in the western part of the State, appearing like the Huron ossuaries of Canada, or rising into mounds. The eastern Iroquois, at least after the formation of their league, did not rebury their dead. They used raised tombs, sometimes a mound of earth, and often a wooden structure like a small house. Burial in circles was secondary; the bodies were laid with their feet toward the center. Graves lined with stones are not frequent, but stone heaps were raised over some graves. Bodies were rarely buried one above another, with an intervening layer of earth. When buried in mounds, or in the bone-pits, they might be placed promiscuously or arranged with care. The mode of sepulture was affected by superstition and in consideration of crime. The New York Indians have for a long time been burying their dead much in the manner of their white neighbors.

How the Woodcock feeds.—A writer in "Forest and Stream" gives the following account of the way he saw woodcock "boring" for worms one moonlight night: "The birds would rest their bills upon the mud and stand in this position for several seconds, as if listening. Then, with a sudden, swift movement, they would drive the bill its entire length in the soil, hold it so for a second, and then as swiftly withdraw it. Though I watched the birds carefully with the glass, I could not detect the presence of a worm in their bills when they were withdrawn. But a subsequent process gave me the clew to their method of feeding. After having bored over a considerable piece of ground—a square foot or more—they proceeded to execute what looked comically like a war-dance upon the perforated territory. They also occasionally tapped the ground with the tips of their wings. My intense curiosity to know the possible utility of this process was at length gratified by seeing a worm crawl, half-length, from one of the borings, when it was immediately pounced upon and devoured by one of the woodcock. Presently another worm made its appearance, and so on until the two woodcock had devoured as many as a dozen of them. Then the 'vein' seemed exhausted, and the birds took their leave. I have subsequently studied the philosophy of this method of digging bait, and have come to the conclusion that certain birds are a great deal wiser than certain bipeds without feathers. If you will take a sharpened stick and drive it into the ground a number of times, in a spot which is prolific with worms, and then tap on the ground with the stick for a few minutes, you will find that the worms will come to the surface, and that they will come up through the holes which you have made. I account for it by the supposition that the tapping of the stick somehow affects the worms the same as the patter of rain, and it is a well-known fact that worms come to the surface of the ground when it rains. The antics of the woodcocks after they had made their borings, then, were simply mimetic, and intended to delude the worms into the belief that it was raining in the upper world. The worms, being deceived, came up and were devoured. All this may seem ridiculous, but, if it is not true, will some naturalist please state how a woodcock can grasp and devour a worm when its bill is confined in a solid, tight-fitting tunnel of soil, and also how it is enabled to know the exact spot where it may sink its bill and strike a worm? And further, of all those who have seen a woodcock feeding, how many ever saw it withdraw a worm from the ground with its bill?"

The Colorado River of Texas.—The Colorado River of Texas is described by Prof. Robert T. Hill as presenting most interesting features, which rival in some respects those of the Colorado of the West. It begins in the dry arroyas which border the eastern scarp of the "Staked Plain," where it has cut cañons nearly a thousand feet deep in the soft Quaternary, Cretaceous, and Triassic strata, recording in their precipitousness both the aridity and the gradual elevation of the region. Between the ninety-seventh and ninety-eighth meridians it cuts through an area of Palæozoic rocks which was the land barrier between the Atlantic Ocean and the inland sea during Mesozoic times. Within the short distance traversed by the Atlantic section of its course, it has worn through the Cretaceous sediments of the plains and now traverses nearly every terrane from the late Quaternary to the earliest Cambrian. "Perhaps nowhere else in the world can be seen a more comprehensive geologic section, a better illustration of sedimentary and igneous rocks and their relation to topographic form and economic conditions and other geologic features dependent upon structure, than in that portion of the Colorado which traverses the counties of Burnet and Travis. . . . Here the erosion of the river-basin has exposed nearly ten thousand feet of structure that would otherwise not be exposed, and every bend serves to reveal some interesting topographic or geologic fact. . . . When it is added," the author concludes, "that no man has ever explored the deep cañons, that the paleontology is almost untouched, that hardly any details of all these grand features have been recorded, one can but feel that the student of geology has here an inexhaustible field before him."

NOTES.

Prof. H. A. Rowland, of Johns Hopkins University, has been elected one of the foreign members of the Royal Society, in recognition of his determination in absolute measure of the magnetic susceptibilities of iron, nickel, and cobalt; his accurate measurements of fundamental physical constants; his experimental proof of the electro-magnetic effect of convection; his theory and construction of curved diffraction-gratings of very great dispersive power; and the effectual aid which he has given to the progress of physics in America and other countries. Prof. Cannazaro, of Rome, and Prof. Chauveau, of Paris, were elected foreign members on the same day.

An experiment has been made at the agricultural station of Champ de l'Air, Vaudois, in hatching trout ova in complete darkness, the water being at a temperature of 5·8° C., or 42·4° F. The hatching was delayed fifteen days by the darkness. The advantages are claimed, in prolonging the incubation, that the young fry put into the streams in April or May more readily find food than in February or March; that they are more vigorous; and that fewer monstrosities are produced.

Experiments in feeding milch-cows, described in the November "Bulletin" of the Massachusetts State Agricultural Experiment Station, attest the great economical value of corn-fodder, stover, and ensilage for the production and quality of milk and cream.

The study of the effect of fertilizers on the quality of fruit is recommended by Prof. P. T. Austen as a line of inquiry distinct from their effect on its quantity. This involves a wide range of investigation, embracing, in fact, all the properties of the plant and the manner in which they are affected by manures, particularly the part played by each chemical substance in the plant and the specific action of fertilizing materials on the formation of those substances; together with the relation of the different species of plants to their chemical composition, and the extent to which plants of the same family produce substances of the same type. The influence of treatment with drugs opens a parallel line of investigation.

The Rev. J. Owen Dorsay is preparing a monograph on Indian names, to contain lists, with English meanings, in six different languages—the whole number of names being thirty-one hundred and forty-six. The connection between the myths and some of the personal names will be considered; and certain classes of names—such as color names, iron names, and the names of composite beings—will be treated in detail.

The latest published volume of Herr Richard Andree's "Ethnographical Parallels and Comparisons" deals with such topics as red hair, albinos, games, masks, marks of property, superstitions connected with the chase, "tree and man," circumcision, drawing among primitive people, thunderbolts, money for the dead, emotional expressions and gestures, demoniacs and mental disorders, etc.

The report of Manchester (England) Technical School for the year ending July 31, 1889, shows an increase of students from 2,871 to 3,328. The most important extension during the year was the opening of a spinning and weaving department. The day classes in this department have but a small attendance as yet, but a considerable number of students are attending the evening sessions.

The suggestion has been made in London that, as the French have erected the highest tower, the English shall dig the deepest hole—say on the exhibition grounds of 1851 in Hyde Park. The pit could be furnished with an elevator shaft, and lit up by electricity; and in each stratum there could be an excavated museum with specimens of the minerals, fossils, etc., afforded by it.

According to a study by Dr. George N. Kreider, of Springfield, Ill., micro-organisms enter the body first by the skin—through lesions, openings of the sweat-pores, or sebaceous ducts, or by the sides of the hairs; and, secondly, by the mucous membrane—through lesions of the membrane, openings of the ducts or follicles, or pockets, sulci, or folds. There are also localized infections, originating in a manner as yet unknown, and giving rise to certain violent diseases; and universal infections, giving rise to hereditary transmissible disease. The severity of the infection varies with the condition of the body as regards idiosyncrasy, or strength, or weakness; the amount of infecting material that gains entrance; the character of the infecting material; and the tissue which it penetrates, and its location.

The underlying motions of the Nile Delta are described by Mr. W. J. Flinders Petrie as those of depression on the coast and upheaval at Ismaïlia. Above these movements great changes have been made by wind-action. In some sites at least eight feet of ground have been removed and deposited in the water. This has partly caused the great retreat of the Red Sea head, and tends to form the characteristic swamps of that district. Formerly the Delta was a desert tract, with valleys inundulated by the Nile. Before historic times the Nile Valley was deep in water, partly estuarine, partly fluvial, and great rainfall then took place. That this was in the human age is shown by the position of worked flints.

A memorial to Prejevalski is to be erected on the shore of Lake Issyk-kul. It represents a rock, upon which an eagle is descending, having a map of Asia in its talons and an olive-branch in its beak. The monument will have the inscription, "To the first explorer of nature in Central Asia."

A correspondent of "Nature" urges that boys should be tested for color-blindness in school—before they go out into life—so that they need not lose the time required for working up to positions on railroads or elsewhere in which ability to distinguish colors is essential.

A curious story is told, by a correspondent of "Nature," of a dog which was struck by lightning and considered dead, but which afterward partly recovered. It continued deaf and blind, and had to depend on its smell for recognition of persons and things.

OBITUARY NOTES.

Prof. Chester S. Lyman, of Yale University, died in New Haven, Conn., January 29th, aged seventy-six years. A sketch of his life and works, and a portrait, were published in "The Popular Science Monthly" for November, 1887.

M. Cosson, member of the French Academy of Sciences, and author of several memoirs on the flora of Algeria and Tunis, died in Paris on the last day of the year 1889. He was President of the Botanical Society of France and Archivist of the Société d'Acclimation.

Dr. William Ramsay McNab, Professor of Botany in the Royal College of Science, Dublin, recently died, suddenly, of heart disease. He was born in Edinburgh in 1844, his father, as his grandfather had been, being Curator of the Botanic Garden there. He studied at Edinburgh, where he was also assistant to Prof. Balfour, and at Berlin, practiced medicine for three years, after which, in 1870, he entered upon a biological career. He introduced important reforms in the method of teaching botany, chiefly by adopting the method of Sachs; was author of numerous works or papers relating to botany and fossil plants; was a practical student of geology; and collected coleoptera. He was appointed in 1888 Swiney Lecturer to the British Museum of Natural Sciences, and was at the time of his death about to begin a third course on fossil botany.

Prof. Lorenzo Respighi, Director of the Osservatorio Campidoglio, Rome, one of the most eminent scientific men in Italy, died December 10th.

The people of Manchester interested in the subject have decided to erect in that city a memorial of James Prescott Joule, which shall take the form of a white marble statue, and also to set up a replica in bronze in some public place in the city. An international monument to James Watt is proposed, to be erected at Greenock, his birthplace, and to take the form of a large and thoroughly equipped technical school.

Senhor José Augusto de Sereza, curator of the zoölogical department of the museum at Lisbon, Portugal, who has recently died, was the author of some useful memoirs on African birds, and of museum catalogues of certain orders.

Edouard Phillipps, an eminent French mechanician and engineer, died December 14th, in his seventieth year. He left important works on mechanics and metallurgy, and his "Lectures" on hydraulics and hydrostatics, published in 1875, was highly appreciated. He was made a member of the Academy of Sciences, in the Section of Mechanics, in 1868.

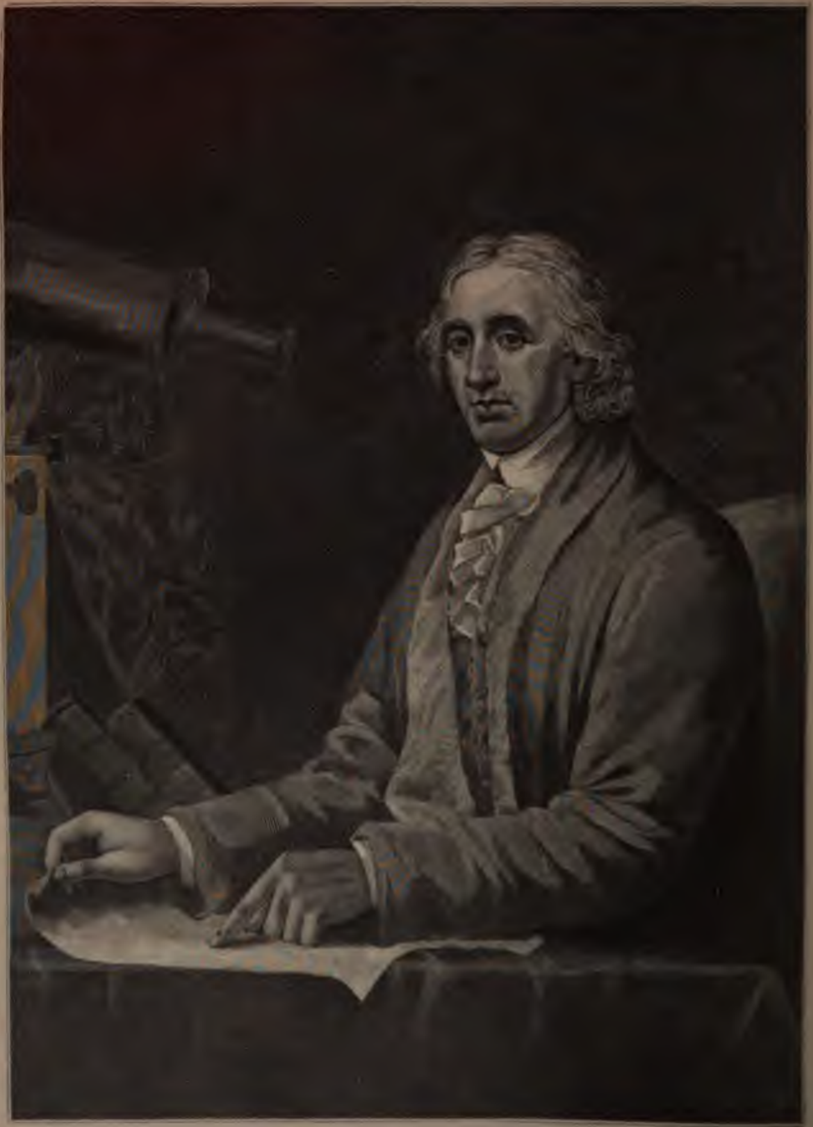
Among the recent foreign deaths is that of the Italian physicist Govi, whose name is closely associated with matters relating to the history of science, particularly in his own country. He prepared an interesting group for the International Electrical Exposition of 1881 of instruments which had been used by Galvani, Volta, and Nobili.

Julien Sacaze, a young epigraphist and archæologist of great repute in the provincial districts of France, has recently died. He discovered a considerable number of prehistoric monuments and sites in and near the Pyrenæan departments, co-operated in the foundation of the Pyrenæan Association and of a more local society at Comminges, and with Dr. F. Garrigo established the "Revue des Pyrénées et de la France Méridionale." The collections which he made in the course of his investigations are described as having been "superb." He left the manuscript of a work on the "Epigraphy of the Pyrenees," which will be published.

Vice-Admiral Cloué, who died in Paris on the 25th of December, was best known for the marine charts he constructed and for his exertions to make of practical value the property of oil in stilling the waves. When he entered the service the French marine was dependent on English or Dutch charts. He substituted for these French charts, many of which he prepared. He was born in 1817 and spent his life in the French naval service or positions connected with it, was appointed Governor of Martinique in 1872, and afterward held the position of Minister of the Marine and the Colonies. He was a member of the Bureau of Longitudes, of the Observatory and the Meteorological Council, and had been elected to a seat in the Institute.

Mr. E. J. Jones, since 1883 an officer of the Geological Survey of India, who died October 15th, aged thirty years, was an associate of the Royal School of Mines and a chemist from the schools of Zurich and Würzburg. He contributed several geological and chemical papers to the publications of the Survey.

Mr. John Tavernier Bartram, who died recently at Stoke's Point, Bermuda, in his seventy-ninth year, was held in high esteem among scientific men as a naturalist. During the forty-two years that he resided at Stoke's Point, says "The Bermuda Colonist," he made a collection of birds, fishes, shells, and other natural curiosities, that has long since come to be "one of the things to be seen in Bermuda"; and for the past twenty-five years no scientific man who visited Bermuda and could get to Stoke's Point ever failed to pay him a visit. He contributed articles to the local press on the natural history and geology of Bermuda, and prepared hand-books on the cage-birds and the shells of the island.



DAVID RITTENHOUSE.

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SCIENCE IN THE HIGH SCHOOL.*

BY PROF. DAVID STARR JORDAN,
PRESIDENT OF THE UNIVERSITY OF INDIANA.

THE purpose of science-teaching as a part of general education is this—to train the judgment through its exercise on first-hand knowledge. The student of science is taught to know what he knows and to distinguish it from what he merely remembers or imagines. Our contact with the universe is expressed in what we call science. Throughout the ages, the growth of the human mind has been in direct proportion to the breadth of this contact. To the man without knowledge of science, the universe seems small. Science is our perception of realities; and as the realities come year by year to occupy a larger and larger place in our life, so the demand for more and better training in science will long be an urgent and growing one. But science should hold its place in the schools by virtue of its power as an agent in mental training, not because of the special usefulness of scientific facts, nor because knowledge of things has a higher market value than the knowledge of words.

The time will come when the study of the objects and forces of nature will be as much a matter of course in all our schools as the study of numbers, but the science-work of the next century will not be the work we are doing now. The science in our schools is too often a make-believe, and the schools will lose nothing when every make-believe slips out of the curriculum. Deeply as I am interested in the progress of science, both in school and out, with Prof. Huxley "I would not turn my hand over" to have biology taught in every school in the land, if the subject is taught through books only. To pretend to do, without doing, is worse than not to pretend. The conventional "fourteen weeks" in science gives no contact with nature, no training of any sort, no information worth having; only a distaste for that class of scattering information which is supposed to be science.

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* Read before the Indiana State Teachers' Association, December 26, 1889.

There is a charm in real knowledge which every student feels. The magnet attracts iron, to be sure, to the student who has learned the fact from a book, but the fact is real only to the student who has himself felt it pull. It is more than this, it is enchanting to the student who has discovered the fact for himself. To read a statement of the fact gives knowledge, more or less complete as the book is accurate or the memory retentive. To verify the fact gives training; to discover it gives inspiration. Training and inspiration, not the facts themselves, are the justification of science-teaching. Facts enough we can gather later in life when we are too old to be trained or inspired.

What is true of one science is true of all in greater or less degree; and I may take the science of zoölogy for my illustration simply because it is the one nearest my hand. In very few of our high schools has the instruction in zoölogy any real value. For this unfortunate fact there are several causes, and some of these are beyond the control of the teachers. In the first place, the high-school course is overloaded, and the small part of the course given to the sciences is divided among too many of them. A smattering of one science is of little value, either for discipline or information. A smattering of many sciences may be even worse, because it leads the mind to be content with smattering. Indeed, so greatly have our schools sinned in this respect that many writers on education seem to regard science as synonymous with smattering, and they contrast it with other branches of learning, which are supposed to have some standard of thoroughness. Most of our colleges have, at one time or other, arranged courses of study not approved by the faculty, in response to the popular demand for many studies in a little time. Such a course of odds and ends is always called "the scientific course," and it leads to the appropriate degree of "B. S."—Bachelor of Surfaces.

The high school can do some things very well, but it will fail if it tries to do too much. Unfortunately, the present tendency in our high schools is in the direction of such failure—to do many things poorly rather than a few things well. Each high school aims to give a general education; to be a university in a small way—a university for the poor—a poor university. In the words of Lowell, "The public schools teach too little or too much; too little, if education is to go no further; too many things, if what is taught is taught thoroughly. And the more they seem to teach, the less likely is education to go further; for it is one of the weaknesses of democracy to be satisfied with the second best, if it appear to answer the purpose tolerably well and is cheaper, which it never is in the long run." In other words, we try to satisfy the public by a show of teaching those subjects which we can not really teach. And so, in the sciences we study books instead of Nature, because books are plenty and cheap, and can be finished quickly, while Nature herself is accessible only to those who want something of her.

The high school would do well not to attempt to give a general view of science. This is possible only in a "Chautauqua course" or in a "school of all sciences." It is better to select some two or three of the number, a physical and a biological science, perhaps, and to spend the available time on these. The choice should depend mainly on the interest or the skill of the teacher. Teach those sciences that you can teach best.

President Hill, of Rochester University, has well said: "Thousands of our youth have studied chemistry without ever seeing an experiment, physics without seeing an air-pump, and astronomy without ever looking through a telescope. A professor of the ancient type maintained that this is a great advantage, like the study of geometry without figures, because it stimulates the imagination. It is an invigoration of stupidity and conceit, sealing the mind to reality by substituting subjective fancies for experimental proofs, and the pretense of knowing for clear ideas. Its effect upon the morals is as pernicious as its effect upon the mind, for it weakens the reverence for truth and engenders the habit of mental trifling."

Even so wise a schoolmaster as Dr. William T. Harris excludes science-teaching (and science-teaching with him means simply giving information about scientific subjects) from the fundamental requirements of education, because the knowledge of nature is not one of the five windows through which the soul looks out on life. These windows, according to Mr. Harris, are reading and writing, grammar, arithmetic, geography, and history. The simile is a happy one. The soul, confined in the watch-tower of mediæval education, looks out on the world through these five windows, and they are but windows, for they give no contact with the things themselves. The study of nature throws wide open the doors, and lets the soul out to the fields and woods. It brings that contact with God through his works which has been, through all the ages, the inspiration of the poets and prophets, as well as of those long-despised apostles of truth whom we call men of science.

A second difficulty is this: Our towns will not pay for teachers enough to do the work as it should be done, and of the few te [illegible] the people make no demand for thorough prepa- [illegible] hem are broadly educated or have had any scientific training whatever. And such teachers are expected to teach a dozen subjects each, and therefore have no time to make good their defective preparation. Thus good teaching of science can not be expected, for streams do not rise higher than their sources. The only remedy for these conditions seems to lie in the gradual education of the people. A series of object-lessons, showing the difference between a good teacher and a poor one, is the most effective means of causing good work to be appreciated.

But taking things as they are, even with uneducated teachers and teachers crowded for time, fairly good work may be done by the use of good methods. A great deal will depend, not on the kind of books you use, but on the kind of books you avoid. Most of the current text-books of elementary zoölogy are simply pernicious so far as your purposes are concerned. Even if these books were well digested and accurate in their statements of fact, which is rarely the case, they are based on incorrect principles. They are not elementary but fragmentary in their character. It is a great mistake to suppose that, because a book is small and says very little about each one of the animals of which it treats, it is thereby rendered elementary. Fragments are not necessarily elements. A fragment of rock is as hard to digest as a bowlder. Elementary work in science should treat of but few things, but the impressions it leaves with the child should be very clear ones. The ideas derived from the common text-books are of the vaguest possible character. These books are the parasites, not the allies, of science. They bear the same relation to the progress of science that barnacles bear to the progress of a ship. If you keep clear of these, you can not go far astray. Let us recall the words of Agassiz to the publisher who tried to induce him to write a school-book on zoölogy:

"I told him," he said, "that I was not the man to do that sort of thing; and I told him, too, that the less of that sort of thing which is done the better. It is not school-books we want, but students. The book of nature is always open, and all I can do or say shall be to lead students to study that book, and not to pin their faith to any other." And at another time he said, "If we study Nature in books, when we go out of doors we can not find her."

The essential of method is that we allow nothing to come between the student and the object which he studies. The book or chart or lecture which can be used in place of the real thing is the thing you should never use. Your students should see for themselves, and draw their own conclusions from what they see. When they have a groundwork of their own observations, other facts can be made known to them as a basis for advanced generalizations, for the right use of books is as important as their misuse is pernicious; but work of this sort belongs to the university rather than to the high school. You do not wish to have your students tell you from memory the characters of the *Sauropsida* as distinguished from the *Ichthyopsida.* What you want is the answer to their own questionings of the frog and the turtle.

I was lately present at a high-school examination in zoölogy. The teacher gave a number of the stock questions, such as "Describe the Gasteropoda." "What are the chief differences between the domestic turkey and the turkey of Honduras?" "How do Asiatic and African elephants differ?" "On which foot of the ornithorhynchus does the webbing extend past the toes?" and so on. At last he said: "I will now give you a practical question: A few days ago we had a frog in the class, and all of you saw it; now write out all the characteristics of the sub-kingdom, class, and order to which the frog belongs."

This is all useless. The definitions of these classes and orders do not concern the child. To the working naturalist these names are as essential as the names of the stations on the road to a railway engineer. They belong to his business, but the names and distances of railway stations do not form part of any good work in primary geography. You do not need to teach your students that vertebrates are divided into mammals, birds, reptiles, batrachians, and fishes. It is not true in the first place, and, if it were, it is not relevant to them. Stick to your frog, if you are studying frogs, and he will teach you more of the science of animals than can be learned from all the memorized classifications that you can bracket out on a hundred rods of blackboard!

The prime defect in our schools is not, after all, that the teachers do not know the subjects they teach, but that they do not know nor care for the purpose of their teaching. In other words, they do not know how to teach. The book is placed in their hands by the school board, and they teach by the book. If the book comes to them wrong-side up, their teaching is forever inverted. That this is true, the statistics gathered last year from the high schools of Indiana, by Prof. Evermann, very clearly show. It is no wonder that a superintendent is needed for every dozen teachers. A good teacher should know the end for which he works, and then he can adapt his means to fit this end.

I once visited a large high school, one of the best in the country, with a science teacher whose studies have won him the respect of his fellow-workers. But for some reason, on that day at least, he failed to bring his own knowledge into the class-room. I heard him quizzing a class of boys and girls on animals—not on the animals of the woods and fields, not on the animals before them, for there were none, but on the edentates of South America. An especial point was to find out whether it is the nine-banded armadillo (*novemcinctus*) or the three-banded armadillo (*tricinctus*) which does not dig a hole in the ground for its nest. The book, written by a man who did not know an armadillo from a mud-turtle, gives this piece of information. It was in the lesson, and the students must get it. And on this and like subjects these boys and girls were wasting their precious time—precious because, if they do not learn to observe in their youth, they will never learn, and the horizon of their lives will be always narrower and darker than it should have been. Already the work of that day is a blank. They have forgotten the nine-banded armadillo and the three-banded, and so has their teacher, and so have I. All that remains with them is a mild hatred of the armadillo and of the edentates in general, and a feeling of relief at being no longer under their baleful influence. But with this usually goes the determination never to study zoölogy again. And when these students later come to the college, they know no more of science and its methods than they did when at the age of one year they first cried for the moon.

Darwin tells us that his early instruction in geology was so "incredibly dull" that he came to the determination, afterward happily changed, "never so long as he lived to read a book on geology or in any way to study the subject."

I once had a student, well trained in the conventional methods of non-science, who was set to observe the yeast-plant under the microscope. He had read what the books say about yeast, and had looked at the pictures. So he went to work vigorously. In a short time he had found out all about the little plant, and had made a series of drawings which showed it very nicely. By and by some one noticed that he was working without any object-glass in his microscope. He had not seen the yeast-plant at all, only the dust on the eye-piece. This is the vital fault of much of our teaching of elementary science. It is not real; it is not the study of nature, only of the dust-heaps of old definitions.

Yet nothing is easier than to do fairly good teaching, even without special knowledge or special appliances. Bring out your specimens and set them before the boys and girls. They will do the work, and do it eagerly; and they will furnish the specimens too. There is no difficulty about materials. Our New World is the "El Dorado" of the naturalists of Europe. You can get materials for a week's work by turning over a single rotten log. I once heard Prof. Agassiz say to an assembly of teachers, and I quote from him the more freely because he gave his life to the task of the introduction of right methods into American schools:

"Select such subjects that your students can not walk out without seeing them. If you can find nothing better, take a house-fly or a cricket, and let each one hold a specimen while you speak. . . . There is no part of the country where, in the summer, you can not get a sufficient supply of the best of specimens. Teach your pupils to bring them in. Take your text from the brooks and not from the booksellers. . . . It is better to have a few forms well studied than to teach a little about many hundred species. Better a dozen forms thoroughly known as the result of the first year's work, than to have two thousand dollars' worth of shells and corals bought from a curiosity store. The dozen animals will be your own. . . . You will find the same elements of instruction all about you wherever you may be teaching. You can take your classes out and give them the same lessons, and lead them up to the same subjects in one place as another. And this method of teaching children is so natural, so suggestive, so true. That is the charm of teaching from Nature. No one can warp her to suit his own views. She brings us back to absolute truth so often as we wander."

ETHICS AND RELIGION.

By CRAWFORD HOWELL TOY,
PROFESSOR OF HEBREW IN HARVARD UNIVERSITY.

NO subjects occupy men's attention more than morality and religion. They are patent, ever-present facts, always intruding themselves on our thoughts, and always demanding consideration. They have formed subjects of human reflection since the race of man began; nations have wrought out practical schemes, philosophers have invented systems; thousands of generations have talked over individual facts and ideas. Yet men are far from being at one on the nature of the two and the relation between them.

One opinion, held widely in our own times, is that religion is the creator of ethics—an opinion not unnaturally suggested by the fusion of ethical and religious ideas and practices which exists among us. The masses of our communities are reared in a religious atmosphere. Their first impressions of duty and right are colored by religious ideas and supported by religious sanctions. The most generally accepted and revered ethical codes are contained in the sacred books, and the most prominent preachers of morals are ministers of religion. Our courts of law dispense justice in the name of the Divine Being. Kings rule by the grace of God, and the Congress of the United States has stamped a declaration of the national trust in God on a silver coin. In many countries religion appears at the birth of a child, to initiate it by a symbolic ceremony into the Church; almost everywhere when life is departing religion comes to care for man's future; and it is religion which announces the [illegible] of life by the solemn deposition of the body in the grave. There are many who hold that both the content and the impulse of ethical life are given by religion; that man can neither know nor do right without divine aid; and that human virtue, apart from the supernatural element, is a delusion and a snare, since it allures men to a fatal self-dependence by holding out the false hope that they can be really good without divine aid. This is the annihilation of morality in the ordinary sense of the term.

On the other hand, the opinion is held that religion and morals are wholly distinct, neither in any wise affecting the fundamental conceptions or the practical development of the other. According to this view, the two start from different points, have regard to different objects, look to different aims, and follow different methods. Sometimes this distinctness is represented as belonging only to the ideal conception of religion and ethics, sometimes it is claimed as a characteristic of the historical development of the two. Religion, it is said, deals with God, ethics with man; and this difference, it is held, severs the two by a world-wide interval. Such a position may be maintained both by those who accept and by those who reject a supernatural divine revelation of truth. A believer in revelation might hold the atonement of Christ to be a distinctively religious fact, while he might regard the ethical teaching of Jesus or Paul as the product of human experience.

Still another view considers the two as different indeed in origin and modes of development, but, since both are essential elements of life existing from the beginning, as acted on and interpenetrated each by the other. It may be held, for example, that the posture of mind necessary to produce ethical convictions is, if not created, at least modified by the religious theory, the consciousness of the presence of the Deity deepening the instinct or conviction of duty toward one's fellow-men; or that, in the inverse direction, the sentiment of duty toward the Deity is quickened by the feeling of human obligation; or, again, that the hope of reward or the fear of punishment from the supernatural powers may furnish a strong motive for right-doing; or that the ideals of duty, constantly transcending practice, and embodied in the Deity, may be an ethically elevating influence. According to this view, the present ethical religious thought of the world is the product of a long series of interactions between ethical and religious ideas which have grown up more or less independently.

In order to test the correctness of these various opinions, we must consider briefly the history of the development of men's religious and moral ideas and practice. Our knowledge of this history can be only a general one: we have not the data necessary to describe the beginning of any line in human life; we do not know with certainty how man formed his first notion of the supernatural, or under what conditions his moral life began. There are hypotheses or surmises which we may think natural or probable; but these must, of course, be distinguished from what is known to be fact. Let us begin by defining the principal terms of our inquiry. Religion is the body of beliefs and practices pertaining to the nature and worship of the Deity, and determining man's effort to propitiate him and secure his aid; ethics is the body of beliefs and practices regulating the conduct of man to man. True, this distinction seems to be sometimes abandoned: the Deity is said to be pleased by ethically right conduct, or a religious ceremonial comes to be regarded as having an ethical character. But even in these cases the distinction really exists. For, the conduct held to be acceptable to God not only relates to intercourse between human beings, but exists as a social custom before it is approved by religion; and the religious ceremonial, primarily designed to secure the divine favor, is ethical only in so far as it involves relations among men. This distinction is not affected by the question respecting a divine revelation of truth, for such a revelation might naturally treat duties to God and duties to man as separate sorts of obligation.

Before, however, entering on the discussion of the subject, it may be proper to ask whether our opinion as to the genesis of ethical practice must be modified by belief in a supernatural, divine revelation of truth. I do not inquire whether such revelations have really been given. It is sufficient for our present purpose to ask whether the objective content of the alleged revelation is of such character as to take it out of the line of natural human development. How stands the case, for example, with the ethical teaching of the Hindu, Persian, and Arabian sacred books? The morality of the Koran is in part high and pure, doubtless an advance on the current usage of Mohammed's time. Yet, leaving out of consideration what was borrowed from Jewish and Christian sources, it contains nothing that may not have been the product of human reflection. The social life of the Arabs of that period was comparatively well organized, and Mohammed undertook for the most part only to modify existing customs—to restrain, for example, the rights of divorce and retaliation; and the duties of honesty, justice, kindness, and mercy which he enjoined were such as would naturally suggest themselves to a large-hearted and keen-sighted man anxious to secure the permanence of a new faith and the well-being of his countrymen. The same thing may be said of the moral codes of Zoroaster, the Veda, and Buddha. Of these the last named is the most remarkable so far as regards purity and depth of ethical perception. It has permanent value quite apart from the Buddhist idea of happiness and perfection as consisting in absolute freedom from thought and feeling; its fundamental principles of self-culture and self-denial involve a noble and spiritual conception of life, and are capable of leading to the most admirable results. But, even with the obscurity that rests on the beginnings of Buddhism and the moral-religious development that preceded it, none of us will be inclined to deny that it is the outcome of the experience and thoughts of the time. Such, also, appears to be the case with the ethical codes of the Bible. The ordinary social duties which are enjoined in the Old Testament and New Testament, such as honesty, truthfulness, sobriety, kindness to the poor, are common to many times and peoples. All the moral requirements of the Decalogue are found among the Egyptians at a period earlier than that usually assigned to Moses. Even the nobler qualities of love to man, forgiveness of injuries, denial of self, are not without parallel in other communities. In some cases a process of natural development may be observed in the biblical ethics. The prophets enjoin on the Israelites justice and kindness to their own countrymen, but their view does not extend beyond their own land; one of the later law-books (Lev. xix, 18) contains the precept, "Thou shalt love thy neighbor as thyself," but it defines neighbors as "the children of thy people"; the great Jewish lawyer Hillel, toward the end of the first century before the beginning of our era, announced as the central principle of conduct that a man should not do to others what he would not have them do to him; Jesus put this principle into positive shape (the same thing substantially existed among the Chinese and Greeks). The ethical treatise of the Egyptian Ptah-hotep, said by Maspero, Renouf, and other eminent scholars to be the oldest book in the world (its date is put before 2000 B. C.), contains a moral code remarkable for loftiness and spirituality; it enjoins gentleness, forgetting wrong, contentment, kindness, avoidance of pride, of hardness of heart, and of bad temper. It would appear, from the codes of peoples for whom no divine revelation is claimed by us, that man by his unaided efforts has come to the knowledge of the best principles and practices of morality, has not only made admirable rules of conduct, but has perceived that the essence of goodness lies in the character of the soul. If this be so, it is unnecessary to suppose a supernatural divine revelation to account for the ethical phenomena of society. It might be said, indeed, that all this ethical development proceeds from a primitive divine revelation. But this statement rests on no historical proof, nor would it explain the fact that the ethical progress of a nation goes hand in hand with its growth in civilization. If the ancient Hebrews received their ethical code directly from God, whence comes it that manners were milder in Ezra's time than in the pre-exilian prophetic period, less mild in the days of David, and comparatively rude in the period of the Judges? It would be singular if the generations which stood nearest the revelation were least affected by it.

Religion consists of creed and ritual. What is the origin and nature of these facts? The religious creed is the embodiment of man's view of the supernatural constitution of the universe. It defines the origin and nature of the powers which stand outside of human life, and the manner in which they brought into being the whole system of things; it describes the character of the relations between them and men, resulting from the attributes of the deities. From these premises the ritual law prescribes the processes by which the favor of the supernatural powers is to be secured.

The main article of the creed, the theology or doctrine of the deity, is the result of reflection. Man demands a ground for the external world, which he naturally at first thinks of as animated by spirits like his own. To these spirits he ascribes passions such as he is conscious of in his own nature. Every object becomes for him a living creature; he refers every phenomenon to an invisible spiritual nature. In process of time he separates the agent from the object or phenomenon, and regards it as an independent power, endowed with such qualities as are suggested by the particular conditions of the case. A deity thus arises, who is gradually invested with a history. Myths which embody natural phenomena or ritual processes, legends which spring from vague recollections of historical occurrences, symbolical stories expressing ethical and other thought gather around his person, and gradually build up for him a distinct individuality. The qualities ascribed to him are modified generation after generation and age after age in accordance with the social development of the community. Starting from his undefined, primitive character, the deity becomes a warrior or a sage, malevolent or beneficent according to the conditions which determine his growth. His ethical nature at any given time will reflect the moral ideas of the community at that time. Man's consciousness of the two opposing elements of good and evil in nature will lead him to apportion beneficial and hurtful attributes and acts among the gods. Those of them who are good will be credited with the best qualities that men can think of, and the bad will tend to become as bad as can be. The latter may then retain their independence and autonomy (as in the Persian religion), or they may be degraded to a subordinate position and retain their power and existence only through the sufferance of the supreme Deity (as among the Hebrews).

This process of constructing the deity supposes a parallel process of self-analysis by man. He finds himself forced by all the conditions of life to inquire into his own nature and needs, and thus gradually builds up an anthropology. This belongs in itself to the domain, not of religion, but of science. But it is the necessary basis of religion. Without the knowledge of man the knowledge of God would be useless for religious purposes; the two go hand in hand. The former springs from and is applied to all the relations of human life. The part of it which comes to be distinctively religious is the consciousness of dependence on God, with all the convictions and feelings which therewith connect themselves. This consciousness has a history similar to that of man's theological creed. It is at first simple and fleshly, relating to man's animal passions and needs; it is purified by time, growing till it attains a well-developed ethical-spiritual shape. From being a creature who needs only food and raiment, man comes to be a highly endowed soul with aspirations after moral perfectness, and at each step the deity must be able to satisfy his needs.

The history of the genesis of things is in itself no more religious than anthropology. How the world, and man, and the gods came into existence are essentially scientific questions; they assume a religious aspect from the fact that they are interwoven with man's really religious conceptions. The first attitude of the human mind on these points is one of indifference; men accept known facts without question. A period of reflection follows; interest is felt in the problem of origins. The construction of the world is assigned, of course, to the supernatural powers; the process of creation is thought of as similar to human methods of work: the world is said to have issued from an egg, or to have been formed from the limbs of a giant, or to have been fashioned in some way familiar to man. The genesis of man is explained in a similar manner. He is born of divine or half-divine parents, or fashioned out of stone or clay. The gods themselves are supposed to have issued from earlier gods, who are held to have come into existence in some far-off time out of primitive material, commonly water. The whole process is one of reflection—it is man's effort to embody in living form the forces which he conceives to have been at work in the creation of the universe. It is his first attempt at scientific analysis and construction.

This theological exposition of the world is a necessity of human thought; man can no more ignore it than he can cease to breathe. It is equally necessary that he should define his own relation to the unseen powers around him. They are believed to determine, in large measure, his weal or woe: they send rain and storm, pestilence and famine, sunshine and food; they smite with disease, or maintain in health; they give victory over enemies, and decide the success or failure of all undertakings. In order to secure their favor and aid, he must know what it is in his conduct that pleases or displeases them, and by what processes their anger may be averted and their good-will obtained. At first, the supposed requirements of human conduct are altogether ceremonial;

but they gradually assume an ethical character. Man ascribes his own conscience to the deity; he can not think of the divine as morally inferior to himself; the divine demands are those which man recognizes in his own conscience.

The forms of the ritual are developed out of social customs. The first idea of the primitive man probably is that the deity is to be propitiated by friendly attentions or by a gift, as a human chieftain or other person would be, and the more precious the gift the better. A man would therefore offer that which he held to be dearest to him—even his own flesh and blood; a human life would be considered the costliest of offerings. All the ceremonies of social life were naturally transferred to the sacrifice of the gods. As eating was so prominent a fact for man, he prepared feasts for his deities; tables were spread, and food and drink were offered. It was assumed that the gods shared men's love of praise; hymns were sung celebrating the divine power and glory. Sometimes a malevolent nature was ascribed to the deity: it was supposed that he was jealous of man's prosperity, and that his displeasure was to be removed by the sacrifice of something which the man esteemed valuable—a costly ring, for example, would be thrown into the sea; but woe to the offerer if it should be found in a fish and returned to him! Out of this primitive material of sacrifices, feasts, praise, and thanksgiving, have arisen all the complicated liturgies and rituals of the world. The outward form of them has followed the customs of society. That which in social intercourse came to be considered seemly and reverent was adopted as the proper attitude toward the gods. The dress of the ministers of religion, words of supplication or praise which they employed, the posture of the worshipers, have always been determined by the forms of human society. The basis of religious service is man's desire to secure the friendship of the deity, its form is determined by the social proprieties. These last must therefore be looked on as an accessory of religion, important as means, but not belonging to its essence.*

Parallel with the religious development is the growth of moral ideas and the elaboration of systems of practical ethics. These also are founded in the nature of things, inasmuch as they have never failed to appear in human society. It is not our purpose here to attempt an explanation of the origin of those instincts on which society is founded, and which furnish the basis of moral character. So far as we know, the complementary instincts of self-maintenance and sympathy are inseparable from the nature of man. They are found, indeed, in the lower forms of being, and were doubtless inherited by man from his ancestors of a lower type; but, in any case, they are now to be considered essential parts of the human constitution, and out of them spring all the details of ethical life. Nor are we called on to discuss the origin of the sentiment of obligation, since we are warranted in holding that it also belongs to the essence of human nature. No man, so far as our information goes, has ever been found to be destitute of it, and, as far as concerns our world, it may be regarded as founded in the nature of things. It is the basis of all moral development. The only question that need be asked is whether it is at all dependent on religion for its essential character—that is to say, at the moment when this sentiment was shaping itself in the mind of man, was its genesis at all conditioned on the recognition of the supernatural? In the decision of such a question we can be guided, of course, only by data of our own consciousness. But the reference to the supernatural does not seem to help the matter much, since we meet here at the outset this same sentiment of obligation. What is the origin of the convictions of duty which man feels toward the unseen powers around him? Does it spring from the recognition of their superiority of position? But this is nothing more than the recognition of a relation which involves the power of harming or helping in the superior being, and, so far as the same power is supposed to reside in men, the same sentiment toward them will arise. Or does the feeling of duty toward the gods come from the recognition of rights belonging to them? Then it does not appear why there should not be a similar recognition of rights belonging to men, since in the earliest conceptions there is no difference between man and the deity, except in the point of power. It does not seem, therefore, that religion has been effective in producing the feeling of obligation, except so far as it has added to the objects toward which this feeling was directed. There would be just as much ground for holding that the sentiment of religious obligation sprang from the feeling of duty which arose between man and man. In point of fact, no doubt, both were products of the same primitive elements of man's constitution. The recognition of an object implies the recognition both of its nature and of those powers in it by which it affects us for good or for bad, and from the interplay of these ideas comes finally the conviction that the object has certain rights; we first perceive and estimate the personality, and then, through experience and reflection, come to the conclusion that it is obligatory on us to allow it such freedom as is consistent with the freedom of other personalities. The degree of liberty we allow will be, in general, in proportion to the power of the personality: men can be controlled by equal powers; the gods, wielding irresistible power, will enjoy perfect liberty. The two sorts of feeling of duty, toward man and toward the deity, grow by mutual action and reaction; each, as it becomes more refined and powerful, communicates something of its qualities to the other. In man's progress in culture of soul there is no part of his nature that does not affect and is not affected by all other parts.

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* It is not here intended to deny that ritual may be a symbolic representation of ideas.

Let us pass on to the details of man's ethical codes. It is generally agreed that the great mass of these spring from the experiences of human intercourse. The ordinary moral rules of life have arisen from men's observation that without them society is not possible. Such is the origin of the feeling against theft, murder, and falsehood. The family life is dependent on the subordination of children to parents, and the tribal or national life on the obedience of subjects to rulers. The early particular perceptions of the law of kindness arise from a compromise between the instincts of self-development and sympathy. A man helps his fellow-man, but not more than is consistent with the maintenance of his own interest. There are special instincts, like that of maternal love, which carry with them absolute self-abnegation. In process of time moral principles acquire a certain universality, and are embodied in ideal forms of men or gods, and these ideals and principles assume an independent shape and enter as independent forces into moral life. Even the broadest and most unselfish ethical conceptions and usages of our best developed societies are thus to be traced back to the habits of thought which arise from social intercourse.

The results of the ethical thought of society are adopted by religion. Observation, as is remarked above, teaches that so soon as the constitution of the community becomes distinctly moral, its religion assumes the same tone—the content of the divine character becomes moral, and the deity is conceived to be pleased by conduct which is in accord with his character. It need not be thought derogatory to religion that it should depend on the experiences of human society for its moral teachings. The essence of religion is not the content of the divine personality, but man's desire to put himself in sympathy with the divine. The ethical character with which man enters into relation is, of course, of extreme importance; but the human mind can not truly appropriate thoughts which it has not learned by experience, and no divine ideal would be effective which had not previously been wrought out by the mind itself.

Such an ideal may exert a powerful influence on life, but only on condition that it correspond with ethical conceptions held by the community in which it exists. If there is a conflict between these two standards, there is in most cases no doubt as to which of them will determine conduct: men will follow their own convictions, preserving a respectful attitude toward the divine, but ignoring its guidance in this point. Illustrations of this fact are probably to be found in all advanced societies. Plato wished to banish the poets from his Republic because he feared the influence of the immoral stories they told of the gods. But his very protest shows that he and the members of his circle had risen above the moral plane of these stories; and, in fact, it is clear from the writings of the period, especially those of Æschylus, Sophocles, Plato, Xenophon, Demosthenes, not to speak of the Stoics, that the moral conduct of men was determined at that time, not by the example of the gods, but by such social considerations as influence us at the present day; it would no doubt have been thought ridiculous if, for example, a man had adduced precedents in the lives of Zeus or Hermes or Aphrodite in defense of conduct condemned by the laws and usages of Athens. A similar ineffectiveness of divine precedent may be observed in Christian societies of our own time, who listen Sunday after Sunday, devoutly but with complete ethical indifference, to procedures represented in the Old Testament as based on divine command, but foreign to our modes of thought. I once heard from a learned clergyman an argument of an hour to show that Abraham's purpose to offer his son could not reasonably be regarded as an example for us, since Abraham was certain that he had the divine command, while we are not warranted in believing that we enjoy personal direction from God of that sort. The occasion of the discourse was the shocking history of a citizen of Massachusetts, who, aided and abetted by his wife, sacrificed his child in obedience to a supposed command from God. But people generally disposed of the matter more simply by saying that the man was crazy, and so he was adjudged to be in a court of law; the general feeling was that no sane man could thus go counter to the ethical principles of our time. The command to exterminate the Canaanites, though it may be vaguely regarded by many as having been right at that time, would not now be pleaded by the general of an army or by a minister of war as authority for wholesale slaughter of enemies. Theoretically these things are widely looked on as divine; but the popular instinct, with easy illogicalness, decides that for some reason or other they do not belong to our times. The explanation, of course, is simple: these procedures were the product of half-barbarous communities, or at any rate of a period when men saw nothing wrong in them; they were repudiated by the moral sense of the later Jews. Slavery, recognized as lawful in the Hebrew and Christian Scriptures, is now condemned by the civilized world; and the New Testament teaching on this subject is explained, by those who hold the biblical ethics to be absolutely correct, as a wise reticence: the apostle Paul, it is said, refrained from interfering with the social institutions of his time, and trusted to the regenerating power of the principles of the gospel. It is true that there is a spirit in the New Testament which is antagonistic to the enslaving of human beings. But it is also true that Paul saw no incompatibility between slavery and Christianity, and it is only recently that the Christian world has come to a definite conclusion on this point. It is not long since devout men in England, Russia, Brazil, and the United States defended slavery on biblical and moral grounds; and the present condemnation of it is to be regarded as a product of the modern social movement toward the recognition of all human rights.

The relation of divine standards to human experience is illustrated in our own times by the discussions on various points of social morals. The Catholic Church, following what it supposed to be the New Testament teaching, affirmed the perpetuity of the marriage relation and the impossibility of divorce. There is a difference of opinion among biblical expositors as to the meaning of the passage in which the Founder of Christianity has expressed his opinion on this point (Matt. v, 32); some hold that there is one scriptural ground of divorce, others that there is none. Modern legislators and social philosophers, however, proceed without reference to the biblical rule. The old church law has been abandoned in most countries, and in the discussions which take place in private circles the arguments on the subject are based not on scriptural grounds but on considerations supposed to connect themselves with the well-being of society. There are many questions for the decision of which there is no specific religious authority; they have arisen from distinctly modern conditions of life, of which the older religious books, of course, take no note. Such questions may often, perhaps always, be brought under general ethical principles announced in the Bible. But the particular application of these principles, the practical decision of present questions of duty, is determined by existing social conditions. Whether capital punishment should be abolished, how far the use of alcoholic drinks should be allowed or prohibited by the state, whether parks and museums should be thrown open to the public on Sundays, whether the theatre should be favored or opposed—these questions are all discussed on modern social grounds.

Has religion contributed any idea to ethics? It might seem at first view that this question must be answered in the affirmative. The Church has at various times imposed laws on the world. The ethical life of Europe has been deeply affected by the church law of divorce. The celibacy of the clergy, a purely ecclesiastical enactment, has had far-reaching moral consequences. In all times and countries the ministers of religion have had more or less to do with the establishment of customs and laws relating to morals. And yet it must be considered doubtful whether, by the authority of ministers of religion or by the experience of the individual conscience, religion has ever originated an ethical principle. We have seen above that the hypothesis of a supernatural divine revelation is not necessary in order to explain the existence of our ethical principles and practices. We have also seen further that these principles and practices have their origin in general not in man's feeling toward the divine, but in his intercourse with his fellow-creatures. There seems to be no rule of ethical usage among us that does not finally go back to our view of its bearing on the well-being of society. This last is the final standard by which we test all our arguments on moral questions. If we wish to decide on the desirableness of flogging on board ships, we ask whether it maintains discipline better than any other punishment, and how it affects the character of the sailor, it being assumed that the proper development of the individual is an essential element of social progress. In the same way we treat all disciplinary problems—capital punishment, solitary confinement, corporal chastisement by parents and teachers: we inquire into the effect on the individual, but the individual as a member of society. We recognize individual rights, but we do not hesitate to sacrifice them to the welfare of the whole. No sympathy with a culprit affects us if we believe that the good of the community requires his punishment. An argument which demonstrates the best social good is considered final. In the prohibition controversies the only point really considered by the disputants is, Does prohibition prohibit? Is war lawful? The answer is given by appeal to the necessities of national life.

But how is it with cases of priestly legislation? Are they not contributions of religion to ethics? In all such cases I believe it will be found that the ethical principle involved is one which has already been established by society and is only applied by religion. As an example let us take the institution of taboo, whose usages are so widely spread in civilized as well as uncivilized countries. Taboo sets certain things apart as sacred or as the special property of gods or men, not to be owned or used by others. Obviously an ethical principle enters here, since the use of tabooed objects by the community becomes wrong; and, as taboo is an essentially religious idea, it may be said that religion has here established a moral rule. But let us see whether this is really the case. The customs of taboo are of two sorts, those which relate to the gods and to persons and places consecrated to their worship, and those which relate to ordinary social intercourse.

The reverence required for images of deities, for sacred buildings and their furniture and ministers, is of course a purely religious sentiment. Of this nature was the sacredness which attached among the Hebrews to the temple and especially to the holy of holies, which none but a minister of religion might enter; and to the sin-offering, which only the priests were permitted to eat. Persons devoted in any way to the Deity were debarred from certain things which were supposed to render them impure; here there was no question of an infringement of a moral law, but only the feeling that contact with or use of certain objects impaired the religious efficiency of the devoted person, probably because such acts and objects were held for some reason to be displeasing to the Deity, or to vitiate the body, or to interfere with the functions of a ministrant. In some cases we can see the grounds for these provisions, in other cases they go back to customs of unknown origin. The Jewish Nazarite was forbidden to eat or drink of the products of the vine or to cut his hair; the first of these injunctions was probably a survival from the old nomadic life, in which the vine was not cultivated (so also in the case of the Rechabites), the second regarded the hair as a seat of life, and therefore as a symbol of the divine presence and authority. The Roman *flamen dialis* enjoyed many privileges as a high representative of a god, but on the other hand was enveloped in an extraordinary mass of restrictions: he could not be out of the city a single night, or sleep out of his own bed three consecutive nights; and no one else might sleep in his bed. He was forbidden to swear an oath; to wear any but a plain ring; to walk along a path covered by vines; to touch flour, leaven, or a dead body; to touch or to name a dog, a she-goat, ivy, beans, or raw flesh. When his hair and nails were cut, the clippings and parings were buried beneath a tree whose fruit could be offered to the superior deities. His wife was surrounded by similar restrictions. Evidently some of these were intended to keep the priest faithful to his duties, to secure his presence at the temple. The objects he was forbidden to touch were doubtless held, from some forgotten customs, to be distasteful to the deity (taboo). That there was no real ethical element in the prohibition appears from the fact that other men might do the forbidden things with impunity. We may compare the modern notions in some communities which require clergymen to wear certain sorts of dress, or insist on their refraining from certain things which are regarded as lawful for other men. A minister of religion offending in these points we regard not as immoral, but rather as improper; a Roman priest so offending would have been looked on as guilty of impiety toward the deity and toward the state.

In undeveloped communities the honors paid to the gods are naturally transferred to chiefs and royal persons supposed to be descended from the gods. We may thus explain the prohibition of the use of their names by other men, and the custom would be so far religious; but it would probably be encouraged by the chiefs on governmental grounds, and would in so far be ethical. Even the religious usage probably goes back to the sentiment of respect felt for the chiefs as rulers.

A number of taboo customs seem to be probably or possibly social. The prohibition of the use of the flesh of a particular animal or of a whole class of animals as food is of uncertain origin. It is supposed by some to result from the idea of *totems*, each tribe refraining from the flesh of its own totem, but other considerations may have entered in part at least into the usage, and the origin of totemism itself is unknown. The rule among some tribes that women shall not eat human flesh is possibly social; it was perhaps intended to guard the character of women. When it is forbidden to touch a dead body or a burial-ground, or a man who has slain an enemy, the idea of pollution thus incurred may be physical, though it may also come from the belief that the dead person is a spirit or inhabited by a spirit. It is possible also that this last may be the ground of the rule that persons dangerously ill should not be touched; here, however, a physical reason may have been effective. The appropriation or protection of property by taboo depends on ordinary principles of social organization. When a chief declares that a certain object is his head or his hand, and thereby secures it for himself, this is merely using the religious sanction to give authority to what we may suppose to be a natural disposition in chiefs, namely, to appropriate as much of the property of their tribesmen as possible. A private man who declares his field taboo, and thus prohibits other men from entering it, is only asserting the right of private property and calling in the aid of religion.

It may fairly be said that those taboo usages which are really ethical arise from ideas which have been established by social intercourse. In the case of the sick person, for example, that certain persons are forbidden to touch him is a religious usage, and if the prohibition were universal, it would be fatal to the sick man; but the helpfulness of those persons who actually tend him comes from the kindly relations engendered by ordinary social intercourse, which overbear the religious prohibition. It does not appear that taboo has ever pronounced any class of actions to be good or bad; it has only brought particular acts under existing moral categories. Neither it nor any other religious institution has ever in the first instance taught men that it was wrong to steal or right to be kind.

So far we have regarded only the content of ethical usage. We now have to ask whether, if religion has received its code from ethics, it has not communicated something in return. It is a noteworthy fact that many great ethical teachers have been at the same time religious reformers; such were Zoroaster, Buddha, Jesus, and Mohammed. In other cases, as in the codes of the Egyptian Ptah-hotep and of Socrates, though there is no religious revolution, a religious atmosphere is present. Where religion seems to be lacking, as in the case of Confucius, still it may be said that the ethical system has arisen in a community permeated with religious ideas. From these facts it might be supposed that religion has been the most powerful influence in the world in the elaboration of moral codes. But it must be borne in mind that at a period when religion was bound up with common life much more closely than now, a practical thinker (and such the great religious reformers were) could not separate the two. In Semitic nations not only morals but government also was bound up with religion. Ethics and religion were so intertwined in human development that, though their origins and laws of growth may have been different, they had come together into a substantial unity.

In thus associating itself with ethics, religion supports it by supernatural sanctions. It is a question of serious import, which doubtless now occupies many minds, whether the moral status of society could be maintained without this external aid. It is a question to which no decided answer can be given, because the experiment has never been tried. The probability is that, if the religious element of thought were now abruptly eliminated from our society, the moral life would suffer enormously if it did not perish outright. Such a sudden withdrawal is, however, impossible, and need not enter into our calculations. The elimination of religion, if it can be conceived of as possible, could be effected only by a very gradual process, during which men would be little by little trained under other influences. The vanishing of religion, indeed, out of human life is hardly conceivable; but we may suppose that the conception of its sanctions may change—the physical-supernatural form of them may give way to the moral. This change has actually begun: a not inconsiderable section of the Christian world now believes that the rewards and punishments which attach to well-doing and ill-doing are determined by natural law, whether in the physical or in the moral life. Nor can we see that the effect of this change on the ethical status of society is bad. If the bodily rewards and punishments have vanished, new and strong ethical motives have been introduced; there is a deeper sense of personal responsibility, and there are higher ideals.

A still more fundamental inquiry is how far the practical ethical life of the world is affected by the belief in future rewards and punishments. But to discuss this point properly would require a collection of data which has not yet been made. It has been said that men are deterred from wrong-doing much more by the fear of immediate punishment than by the prospect of a retribution which seems indefinitely remote. Such, certainly, appears to a superficial view to be the state of the case; a keen observer of human life long ago remarked that because sentence against an evil work is not executed speedily, therefore the heart of the sons of men is fully set in them to do evil. But who can read the deeper-lying motives of men? Who knows what profounder ethical direction is given to life by the constant contemplation of recompense beyond the grave? The history of human virtue and vice has unfolded itself, almost without exception, in the atmosphere of this belief. One noted exception there is—the early Semites, the Assyrians, and the Jews prior to B. C. 300, appear to have lived practically without recognition of the future, and it does not seem that their morality was inferior to that of other nations; we ourselves indeed must acknowledge that, so far as our practical life is concerned, we have something to learn from the codes of the prophets and the law. But it must be said, on the other hand, that the Jews of that time had a powerful ethical stimulus which is wanting in our time—namely, a vivid belief in the immediateness of divine interventions in human life. An experiment of a morality supported only by human sanctions has never been tried in modern times on a large scale. Nor can it be doubted that the belief in future retribution exerts a powerful influence on men's lives. Strictly speaking, however, this belief does not belong to the domain of religion. Its precise origin is doubtful, but it has arisen from man's reflection on his own life, and not on his relation to the Deity. Its relations with both religion and ethics are close, but it can not properly be said to represent an influence of the former on the latter.

It appears, then, that the real substance of man's ethical code has not been affected by religion. The belief in supernatural rewards and punishments, though it influences men's conduct, is not a moral force; it has no power to change the heart. The true salutary influence of religion on human life is found in the creation of divine ideals to be loved and imitated. Such an ideal is the embodiment of man's own highest ethical conceptions. Vitalized into a person, ethical perfectness acquires an independent power, attracting and stimulating us, lifting us up above the ordinary low level of our lives, inspiring us by presenting a goal to be reached, and encouraging us with the hope of divine aid. The standard of human achievement is expressed in the exhortation of Jesus to men to be perfect as God is perfect, and the proper emotional attitude in the Old Testament declaration that men are to love God with all the heart. Such a love toward God as a perfect being implies the love of right in man's soul; but this love may exist in incomplete or feeble form, and may be heightened and developed by constant contemplation of ideal goodness; it is still further aided by the sentiment of gratitude in response to benefits believed to have been received from the hand of God.

The effect of such ideals is both to ennoble individual character and to elevate the moral standard of the community. A conception of perfectness formed by the best minds always goes beyond the general practice, and calls into being principles of action which gradually make their way from the few to the many. A gradual reorganization of society is thus effected; social intercourse is based on these enlarged ethical views, habits spring up in accordance with them, they create new grooves for men's sympathies and interests, so that it becomes, as a rule, easier to act with than against them, easier in general to do right than to do wrong. It is impossible, however, to define the influence of the ideal precisely, to separate it from the general effects of social life. Take, for example, the principles of forgiveness and revenge as they exist among us. The recognized religious ideals in all parts of this country inculcate the duty of forgiveness of injuries, and yet the practice varies greatly in different regions. The difference of custom appears to depend chiefly on difference of social organization. In those communities which are semi-feudal in character, where there is comparatively little social organization, and individuality of action has been cultivated, the habit of revenge for personal injuries is more common; while in those communities in which commercial interests are stronger, and social combinations firmer and more numerous, personal vengeance is rarer, and the appeal to society and law more frequent. Whether there is a corresponding difference in the temper of the soul may be a question; yet it is probable that the constant habit of refraining from private retaliation induces a more peaceful and self-restraining attitude of heart. The effect of the religious ideal is, however, seen in individuals in all Christian communities, who practice forgiveness out of loyalty and love to the divine lawgiver. And it is impossible to say how far this ideal has everywhere affected the feeling of men through the example of those who have manifested obedience to the religious law of forgiveness.

There are, of course, ethical as well as religious ideals, and these have had their due effect. The moral progress of men has been effected by the combination of the two great factors, the organization of society and ethical-religious ideals. Every step taken toward binding men closer together in social life, and every announcement and practical exhibition of a supereminent ethical principle is an element of advance toward social perfection. The progress may be largely external, and change of heart does not always accompany conformity to rule; nevertheless, long-continued habit is almost sure to produce change in men's conception of life.

DARWIN ON THE FUEGIANS AND PATAGONIANS.*

HAVING now finished with Patagonia and the Falkland Islands, I will describe our first arrival in Tierra del Fuego. A little after noon we doubled Cape St. Diego and entered the famous Strait of Le Maire. We kept close to the Fuegian shore, but the outline of the rugged, inhospitable Staten-land was visible amid the clouds. In the afternoon we anchored in the Bay of Good Success. While entering we were saluted in a manner becoming the inhabitants of this savage land. A group of Fuegians, partly concealed by the entangled forest, were perched on a wild point overhanging the sea; and, as we passed by, they sprang up and waving their tattered cloaks sent forth a loud and sonorous shout. The savages followed the ship, and just before dark we saw their fire, and again heard their wild cry. The harbor consists of a fine piece of water half surrounded by low, rounded mountains of clay-slate, which are covered to the water's edge by one dense, gloomy forest. A single glance at the landscape was sufficient to show me how widely different it was from anything I had ever beheld. At night it blew a gale of wind, and heavy squalls from the mountains swept past us. It would have been a bad time out at sea, and we, as well as others, may call this Good Success Bay.

In the morning the captain sent a party to communicate with the Fuegians. When we came within hail, one of the four natives who were present advanced to receive us, and began to shout most vehemently, wishing to direct us where to land. When we were on shore the party looked rather alarmed, but continued talking and making gestures with great rapidity. It was without exception the most curious and interesting spectacle I ever beheld: I could not have believed how wide was the difference between savage and civilized man: it is greater than between a wild and domesticated animal, inasmuch as in man there is a greater power of improvement. The chief spokesman was old, and appeared to be the head of the family; the three others were powerful young men, about six feet high. The women and children had been sent away. These Fuegians are a very different race from the stunted, miserable wretches farther westward; and they seem closely allied to the famous Patagonians of the Strait of Magellan. Their only garment consists of a mantle made of guanaco-skin, with the wool outside; this they wear just thrown over their shoulders, leaving their persons as often exposed as covered. Their skin is of a dirty coppery-red color.

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* From advance sheets of a new edition, illustrated by R. T. Pritchett, of Darwin's "Journal of Researches" made during the voyage round the world of H. M. S. Beagle. In preparation by D. Appleton & Co.

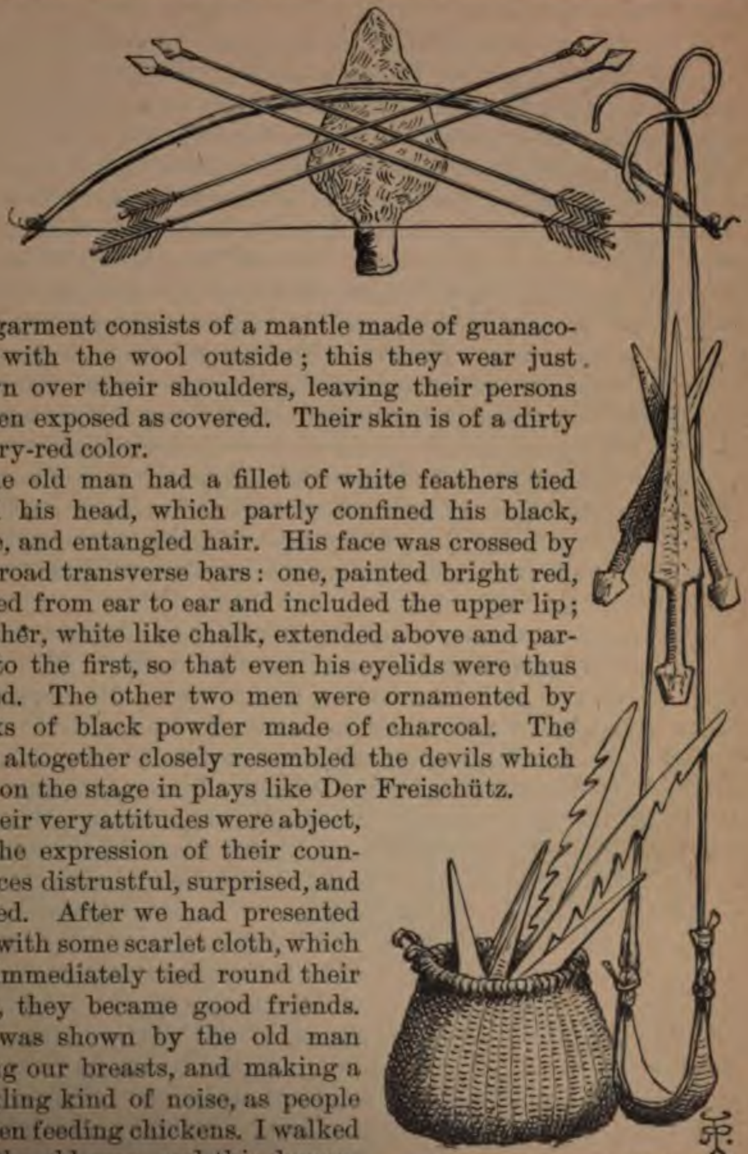

Fig. 1.—Fuegian Basket and Bone Weapons.

The old man had a fillet of white feathers tied round his head, which partly confined his black, coarse, and entangled hair. His face was crossed by two broad transverse bars: one, painted bright red, reached from ear to ear and included the upper lip; the other, white like chalk, extended above and parallel to the first, so that even his eyelids were thus colored. The other two men were ornamented by streaks of black powder made of charcoal. The party altogether closely resembled the devils which come on the stage in plays like Der Freischütz.

Their very attitudes were abject, and the expression of their countenances distrustful, surprised, and startled. After we had presented them with some scarlet cloth, which they immediately tied round their necks, they became good friends. This was shown by the old man patting our breasts, and making a chuckling kind of noise, as people do when feeding chickens. I walked with the old man, and this demonstration of friendship was repeated several times; it was concluded by three hard slaps, which were given me on the breast and back at the same time. He then bared his bosom for me to return the compliment, which being done, he seemed highly pleased. The language of these people, according to our notions, scarcely deserves to be called articulate. Captain Cook has compared it to a man clearing his throat, but certainly no European ever cleared his throat with so many hoarse, guttural, and clicking sounds.

They are excellent mimics: as often as we coughed or yawned, or made any odd motion, they immediately imitated us. Some of our party began to squint and look awry; but one of the young Fuegians (whose whole face was painted black, excepting a white band across his eyes) succeeded in making far more hideous grimaces. They could repeat with perfect correctness each word in any sentence we addressed them, and they remembered such words for some time. Yet we Europeans all know how difficult it is to distinguish apart the sounds in a foreign language. Which of us, for instance, could follow an American Indian through a sentence of more than three words? All savages appear to possess, to an uncommon degree, this power of mimicry. I was told, almost in the same words, of the same ludicrous habit among the Caffres; the Australians, likewise, have long been notorious for being able to imitate and describe the gait of any man, so that he may be recognized. How can this faculty be explained? Is it a consequence of the more practiced habits of perception and keener senses, common to all men in a savage state, as compared with those long civilized?

When a song was struck up by our party, I thought the Fuegians would have fallen down with astonishment. With equal surprise they viewed our dancing; but one of the young men, when asked, had no objection to a little waltzing. Little accustomed to Europeans as they appeared to be, yet they knew and dreaded our firearms; nothing would tempt them to take a gun in their hands. They begged for knives, calling them by the Spanish word *cuchilla*. They explained also what they wanted, by acting as if they had a piece of blubber in their mouths, and then pretending to cut instead of tear it.

It was as easy to please as it was difficult to satisfy these savages. Young and old, men and children, never ceased repeating the word *yammerschooner*, which means "give me." After pointing to almost every object, one after the other, even to the buttons on our coats, and saying their favorite word in as many intonations as possible, they would then use it in a neuter sense, and vacantly repeat *yammerschooner*. After yammerschoonering for any article very eagerly, they would by a simple artifice point to their young women or little children, as much as to say, "If you will not give it me, surely you will to such as these."

There is one vegetable production deserving notice from its importance as an article of food to the Fuegians. It is a globular, bright-yellow fungus, which grows in vast numbers on the beech-trees. When young it is elastic and turgid, with a smooth surface; but when mature it shrinks, becomes tougher, and has its entire surface deeply pitted or honeycombed, as represented in the accompanying woodcut. This fungus belongs to a new and curious genus. I found a second species on another species of beech in Chili; and Dr. Hooker informs me that just lately a third species has been discovered on a third species of beech in Van Diemen's Land. How singular is this relationship between parasitical fungi and the trees on which they grow, in distant parts of the world! In Tierra del Fuego the fungus in its tough and mature state is collected in large quantities by the women and children, and is eaten uncooked. It has a mucilaginous, slightly sweet taste, with a faint smell like that of a mushroom. With the exception of a few berries, chiefly of a dwarf arbutus, the natives eat no vegetable food besides this fungus. In New Zealand, before the introduction of the potato, the roots of the fern were largely consumed; at the present time, I believe, Tierra del Fuego is the only country in the world where a cryptogamic plant affords a staple article of food.

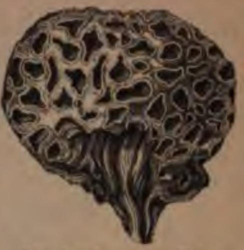

FIG. 2.—CYTTARIA DARWINII.

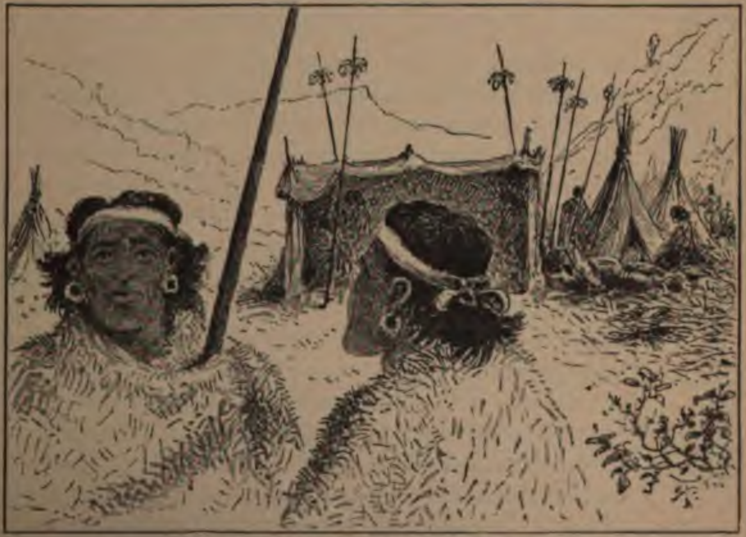

FIG. 3.—PATAGONIANS FROM CAPE GREGORY.

In the end of May, 1834, we entered for the second time the eastern mouth of the Strait of Magellan. The country on both sides of this part of the strait consists of nearly level plains, like those of Patagonia. Cape Negro, a little within the second Narrows, may be considered as the point where the land begins to assume the marked features of Tierra del Fuego. On the east coast, south of the strait, broken, park-like scenery in a like manner connects these two countries, which are opposed to each other in almost every feature. It is truly surprising to find in a space of twenty miles such a change in the landscape. If we take a rather greater distance, as between Port Famine and Gregory Bay, that is about sixty miles, the difference is still more wonderful. At the former place we have rounded mountains concealed by impervious forests, which are drenched with the rain brought by an endless succession of gales; while at Cape Gregory there is a clear and bright blue sky over the dry and sterile plains. The atmospheric currents, although rapid, turbulent, and unconfined by any apparent limits, yet seem to follow, like a river in its bed, a regularly determined course.

During our previous visit (in January), we had an interview at Cape Gregory with the famous so-called gigantic Patagonians, who gave us a cordial reception. Their height appears greater than it really is, from their large guanaco mantles, their long, flowing hair, and general figure; on an average their height is about six feet, with some men taller and only a few shorter; and the women are also tall; altogether, they are certainly the tallest race which we anywhere saw. In features they strikingly resemble the more northern Indians whom I saw with Rosas, but they have a wilder and more formidable appearance: their faces were much painted with red and black, and one man was ringed and dotted with white like a Fuegian. Captain Fitz Roy offered to take any three of them on board, and all seemed determined to be of the three. It was long before we could clear the boat; at last we got on board with our three giants, who dined with the captain, and behaved quite like gentlemen, helping themselves with knives, forks, and spoons: nothing was so much relished as sugar. This tribe has had so much communication with sealers and whalers that most of the men can speak a little English and Spanish; and they are half civilized, and proportionally demoralized.

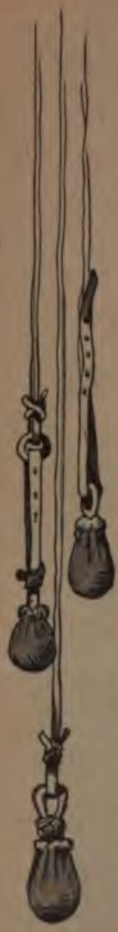
Fig. 4.—Patagonian Bolas.

The next morning a large party went on shore, to barter for skins and ostrich-feathers; firearms being refused, tobacco was in greatest request, far more so than axes or tools. The whole population of the *toldos*, men, women, and children, were arranged on a bank. It was an amusing scene, and it was impossible not to like the so-called giants, they were so thoroughly good-humored and unsuspecting; they asked us to come again. They seem to like to have Europeans to live with them; and old Maria, an important woman in the tribe, once begged Mr. Low to leave any one of his sailors with them. They spend the greater part of the year here; but in summer they hunt along the foot of the Cordillera; sometimes they travel as far as the Rio Negro, seven hundred and fifty miles to the north. They are well stocked with horses, each man having, according to Mr. Low, six or seven, and all the women, and even children, their one own horse. In the time of Sarmiento (1580) these Indians had bows and arrows, now long since disused; they then also possessed some horses. This is a very curious fact, showing the extraordinarily rapid multiplication of horses in South America. The horse was first landed at Buenos Ayres in 1537, and the colony being then for a time deserted, the horse ran wild; in 1580, only forty-three years afterward, we hear of them at the Strait of Magellan! Mr. Low informs me that a neighboring tribe of foot-Indians is now changing into horse-Indians; the tribe at Gregory Bay giving them their worn-out horses, and sending in winter a few of their best skilled men to hunt for them.

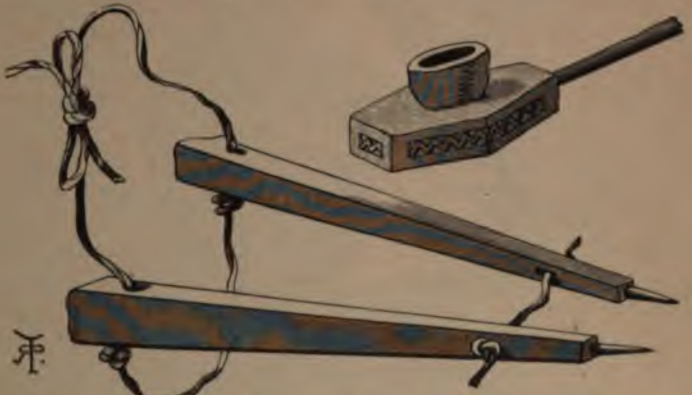

FIG. 5.—PATAGONIAN SPURS AND PIPE.

June 1st.—We anchored in the fine bay of Port Famine. It was now the beginning of winter, and I never saw a more cheerless prospect; the dusky woods, piebald with snow, could be only seen indistinctly through a drizzling, hazy atmosphere. We were, however, lucky in getting two fine days. On one of these, Mount Sarmiento, a distant mountain six thousand eight hundred feet high, presented a very notable spectacle. I was frequently surprised, in the scenery of Tierra del Fuego, at the little apparent elevation of mountains really lofty. I suspect it is owing to a cause which would not at first be imagined, namely, that the

H. M. S. Beagle in Straits of Magellan.—Mount Sarmiento in the Distance.

whole mass, from the summit to the water's edge, is generally in full view. I remember having seen a mountain, first from the Beagle Channel, where the whole sweep from the summit to the base was full in view, and then from Ponsonby Sound across several successive ridges; and it was curious to observe in the latter case, as each fresh ridge afforded fresh means of judging of the distance, how the mountain rose in height.

IS EDUCATION OPPOSED TO MOTHERHOOD?

By ALICE B. TWEEDY.

IF, as Max Müller asserts, the first duty of honest philosophers is definition, there can be no doubt that in following it many clouds of discussion may be swept away. Definitions are continually assumed, and we clothe our creeds in wordy obscurity that totally hides their nature. No subject suffers more from this error than the woman question. If debated words were rigidly defined, and results placed barely before us, many sentimental arguments would fail in foundation.

In "Plain Words on the Woman Question,"[*] Mr. Grant Allen discusses a topic which, he thinks, is "too much overlooked by modern lady writers." It is the continuation of the human race. Intrenched behind population and marriage statistics, he opens fire upon feminine reformers from a quarter where they have made little defense. His text is—if a race will continue, it must reproduce itself. His argument may be briefly given as follows:

I. Marriages are decreasing in England and America.

II. Women of the cultivated classes are becoming unfitted for motherhood.

III. The movement which demands the independence and higher education of women is responsible for this—it creates a "spiritless epicene automaton" and the "self-supporting spinster."

IV. The emancipation of women, especially from Mrs. Grundy, is desirable; but it must not conflict with the existence of mothers who are necessary to the race.

Mr. Allen states the needful conditions of a stationary population in this manner: A father and mother are exactly represented in another generation by two children, a boy and a girl. But, in order that two may attain maturity, four[†] must be born; so that either every woman must have four children, or those who do marry must have more than four to make up the requisite number. From this he deduces: "The best ordered community will be one where as large a proportion of women as possible marry. Where many marriages and small families are the rule, the children will on the average be born healthier, be better fed, and be launched more fairly on the world in the end."

After clearly stating and carefully explaining these indisputable facts, Mr. Allen startles us by acknowledging that "it may be brutal and unmanly to admit or insist upon them," as he has been

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[*] "Popular Science Monthly," December, 1889.

[†] This number is based upon the present proportion of children who become healthy adults, statistics which ought to be materially altered for the better.

"often told it is by maiden ladies"! There is but one intelligent attitude concerning them—are they true or false? Granting, then, that these conditions are truthfully represented, what can be said to the argument which Mr. Allen founds upon them?

I. Marriages are decreasing in many civilized countries. There are local causes for this tendency among men, but the principal and prevailing one with women is that they are passing from the rule of force to a state of freedom, and use their newly found liberty to reject what seems to hamper and handicap them. They are emerging from the condition in which marriage is consequent upon physical or social constraint, and they have not generally arrived at the point where it is for them the result of deliberate choice or response to natural instinct. In China, India, Persia, and Arabia, where marriages are still controlled by force, the number would be diminished at once, without the influence of higher education or industrial training, were the women allowed simple freedom of choice.[*] This decrease would not indicate "the dulling of feminine instinct," but the vitality of it—since marriages are made there in defiance of natural selection, and represent the worst condition of servitude. In more civilized states the popularity of marriage does not depend wholly upon the way in which women regard it, but upon the way in which it is treated by men. The laws of some countries render it easier for a man to live illegitimately with a woman than to marry her;[†] true marriage is discouraged by social usage and dishonored by false philosophy. Few thoughtful minds will deny that the customs which render it difficult for a young man to marry, which send him hither and thither to gain a fortune, succeed in a profession, or dissipate his strength, when he should be choosing his sweetheart, are harmful, and divert men "from the true problem of their sex to fix it on side issues of comparative unimportance."

Boys, as well as girls, should be taught that the full meaning of human life is missed unless they deserve and find a fitting mate. Authors who represent wifehood and maternity[‡] as onerous and unattractive, however necessary, or who surround illicit and incomplete love with superficial glamour, are open to the charge of depreciating marriage. Guests are not tempted to a banquet by fear of starvation, nor are men attracted toward matrimony for the interests of the race. Instead of showing that marriage offers the greatest possibility of happiness, it is often described by men as an unintellectual, slavish, and pitiable condition. Few epithalamia are sung by the generation which asks, "Is marriage a failure?" and rare is the poet who writes:

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[*] It is related that in 1878 eight young girls living near Canton, having been betrothed, arrayed themselves one evening in fine attire, bound themselves together, and plunged into the river to avoid marriage.

[†] In Germany, where marriage is forbidden the younger soldiers, the birth statistics are disadvantageous to the state.

[‡] Some English conservatives discourse on these topics in a strain wholly abhorrent to healthy women. They write of "the *inexorable law* from which, however *distasteful*, a woman can not escape"; "the *stern* law that makes women wives and mothers." One would imagine from them that marriage and motherhood made a yawning grave of hope and aspiration. Normal women, who have passed through these experiences, see no woful error in description.

"Clear as amber, fine as musk,
Is life to those who, pilgrim-wise,
Move hand in hand from dawn to dusk."

II. Mr. Allen seems to regard as evidence that women "are becoming unfitted for motherhood" the fact that they do not glory in their femininity, and charges also that women reformers speak and write "as though it were desirable that the mass of women should remain unmarried forever." Worse even than this, he asserts: "At the present moment a great majority of the ablest women are wholly dissatisfied with their own position as women, and with the position imposed by the facts of the case upon women generally; this as the direct result of their false education." Here are two ideas badly entangled for want of definition—the natural and the artificial position of women. Mr. Allen gives us on the following page his opinion of "the position" (artificial) of women in language strong enough for the most blatant reformer. "The position of women was not a position which could bear the test of nineteenth-century scrutiny; . . . their relation to the family, to their husbands, their children, their friends, their property, was simply insupportable." (Does he demand of these ablest women that they should be satisfied with a position he calls "insupportable"?) But, let him not be distressed because woman does not openly "glory" in her natural position of womanhood. There is no failure of healthy instinct here, but a natural feminine divergence from the masculine feeling. The differentiation of the sexes is a subject upon which we have no adequate data. We might as well try to surmise the habits of the wild cat from the domesticated pussy, as to speculate upon the essential qualities of free womanhood. But, so far as woman's physical constitution indicates anything, it points toward greater reserve on her part than is exhibited by man. This corresponds with the almost universal inclination of women to be more modest than men.* Therefore, though a woman may prefer her own sex and be proud of her privileges as woman, she will not voluntarily go about "glorifying" her womanhood. If Mr. Allen should meet a young woman who announced herself a candidate for motherhood, it is doubtful whether he would approve of her, although she embodied his theory.[*]

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* A few savage tribes form exceptions to this rule.

Here, also, Mr. Allen misinterprets the women reformers of England. He states that they "openly refuse and despise marriage." Some may; some write very bitterly of men. But this refusal is for themselves, or for the class to which they belong—reformers. In this they do not differ from a large number of religious or political enthusiasts of both sexes, in every age, who claim that their "cause" is superior to individual rights or duties. Who is the woman in England who maintains such doctrine for the majority of her sex? One of the ablest advocates for women, Emily Pfeiffer,[†] writes to her countrymen:

> "You do not well to rest your hope
> On natures of a narrower scope,
> And leave the souls which, like your own,
> Aspire, to find their way alone—
> To go down childless to their graves,
> The while you get your sons of slaves."

Though men have greatly outgrown tyranny of thought and action, there is still alive much masculine arrogance. With many it is entirely unconscious; it probably is so with Mr. Allen when he calls a literary or scientific education "mannish." I do not know of any purely mannish training except that received by the monks of La Trappe, and that which fits men to be soldiers, sailors, blacksmiths, or workmen whose physical force is a necessity to their calling. A college or university education, although in past years given exclusively to men, was never supposed to fit them for any essentially masculine occupation, not even to become the fathers of the future race. It was preliminary to a professional or literary career, and intended to develop the powers of mind. And mind—emphasize as we will the physical differences of the body that goes with it—has no discoverable gender. The lavish way in which the epithet of "masculine" or "feminine" has been applied to particular minds is utterly destructive of precision of thought. Vigorous minds are called masculine and those of the namby-pamby, sentimental sort are dubbed feminine. This classification may be historically justifiable by the slight appearance women have made in the literary and scientific world, but there have been clear-headed women enough in all antiquity, and there are too many well-developed minds among them to-day, not to make them resent further tricking out with masculine trappings. The wise old Greeks saw fit to personify mind in a woman; the moderns seem to be afraid of such a result.

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[*] In college days I knew a young lady medical student who illustrated this doctrine. She openly proclaimed that she studied medicine for the purpose of fitting herself to become a wife and mother. She enlarged her waist, wore most ungraceful garments, broached her pet idea on social occasions, and was the *bête noire* of her companions. Perhaps she was Mr. Allen's ideal of an emancipated woman. Her fellow-students thought she had missed the inheritance of womanly instinct, or that some secondary male characteristic had cropped out in her. At last accounts she had not put her precepts into practice.

[†] "A Rhyme for the Time," "Contemporary Review."

If education must be specialized, and women should be fitted to become wise mothers, then, in all fairness, men should be trained to become intelligent fathers. Their lack in this respect is as palpable to any just mind as the failure of women in motherhood. That there should be fathers, and good fathers, is no less important, from a utilitarian standpoint, than that there should be good mothers. Indeed, it may be questioned whether there are not annually more children lost to the world through the wickedness and ignorance of male parents[*] than would be gained by the conversion of all "self-supporting spinsters" into model matrons. It is not necessary to enter into detail here, but appalling statistics are easily obtainable. Until no foundling hospital, no abandoned family exists, it is ungenerous to reproach woman with evading or "shirking" her natural duties. Postponement of marriage by men results in another not inconsiderable evil, false marriage[†] of many young women. Nature often revenges herself here by a lack of mothers. The wiser plan would be to follow the teaching of Nature and not dissociate the sexes, particularly during impressionable years. In study, work, or society, do not bar them from each other; then they will not form the erroneous notions that taint maturity. Let them be "human, instead of half-human."

III. The most evident good of education to woman, aside from the discipline of mind and development of power, is in its teaching observation of nature and the intelligent use rather than the repression of any instinct or force. Those who assert that these influences "unsex" woman, render her "unwomanly," should explain what is meant. She may lose some of the characteristics that have distinguished her in the past, but while analytic or radical minds call these characteristics local and temporary, conservatives cling to them as part of essential womanhood. It may be observed that, although Mr. Allen holds fast to the term of "radical," he agrees with our dear old great-grandmothers in this apprehension that education[‡] and independence unfit women to become mothers. To these timid souls may be recommended a

[*] Meaning the sex as a whole. The large class with which we are best acquainted includes fathers whose fidelity to duty and patient toil equal, if they do not surpass, those of the hardest-working mothers.

[†] Marriage under coërcion, or from social or ambitious motives, ignores natural selection, and is often unproductive. A striking example of this is given in France, where false marriage prevails.

[‡] The same education as that given to man.

greater trust in Nature, that she will be able to maintain the differences necessary to a continuance of the race.[*] Clothes and customs vary with time and place; sex is stable and not injured by anything but physical condition. The traditional idea that womanhood can be modified in some occult[†] way by occupation, training, or environment, is wholly unscientific and *baneful;* for it undoubtedly serves to nurse in many a woman that "slavishness of soul" which Mr. Allen, as a true well-wisher of woman, deplores. Physical condition, then, is the constant coefficient in the problem. Anything injurious to the health of either man or woman incapacitates each just so much for the fullest requirement of life.

Mr. Allen claims that the result of the higher education in England and America has been to convert woman into "a dulled and spiritless epicene automaton." Now, this peculiar product, which I take to mean the opposite of a healthy woman, must be wholly within the reach of statistics, else she, or it, is a fabulous affair. In England it is possible she may exist, but the best available statistics of Girton, Newnham, and Cheltenham prove that she is not typical. The following testimony in regard to women students is given:[‡]

"I have known intimately Girton and Newnham Colleges and what is now the women's department of Owens College, Manchester. . . . Were an impression to get abroad that a thorough school and college education is injurious to tolerably healthy women, it would be as *mistaken* as it would be unfortunate" (Miss Bulley).

"My unqualified testimony is, that the intellectual quickening resulting from advanced education is of great benefit to their physical condition" (Miss Mackillip, Londonderry Collegiate School).

"I have been head of this college for more than twenty-eight years. . . . *We have kept the minutest possible statistics*[§]—these show that girls, working under proper conditions, are exceptionally healthy" (Miss Beale, Cheltenham College).

Mr. Fitch, inspector of training schools, testifies: "There are in England twenty-six training colleges for schoolmistresses, containing in all eighteen hundred resident students. It is my duty, on behalf of the Government, to make an annual visit to these institutions, and I have seen every one of them during the last twelve months. . . . It is the uniform opinion of the medical officers that the students improve in health and vigor during their two years of residence."

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[*] The average notion of manliness or womanliness is very fluctuating. A young man showing great interest in laces and hosiery would be considered to-day an effeminate fellow; yet in the time of Charles I such attention to fripperies was deemed manly enough.

[†] "Principles of Biology," Herbert Spencer; "Sex in Mind and in Education," Henry Maudsley, M. D.

[‡] "Woman and Work," Emily Pfeiffer, pp. 115, 117, 128.

[§] Six hundred and twenty-seven pupils passed senior and higher university examinations.

In America, the dulled automaton is not discoverable; indeed, the records are so much in favor of a healthier class than the average of women that physicians who have hastily committed themselves to an opposite opinion say, upon examination, that they "utterly distrust the statistics"![*] The necessary amount of this distrust, and the direction in which it is exercised, may be estimated by citing the authorities for the health of women students: Secretary of the Society of Associated Alumnæ of American Colleges,[†] seven hundred and five alumnæ who report personally; Committee of Education, 1883–'84, Washington; Addresses of President Angell, of Michigan University; ex-President White, of Cornell; and President Horace Davis, of the University of California.

But, it may be asked, "Are doubting physicians not justified at all—are there no women students who break down[‡] or die?" There are such cases of overstrain or feeble constitution which find their parallel among men, but the percentage among women is so small that it leaves the health average still above the generality of women.

But, urges Mr. Allen, there is "the self-supporting spinster"; "almost every woman should marry"; and she is "a deplorable accident." Now, it is possible that while I may deem her admirable, another may consider her "deplorable"—it is a matter of taste merely. But, that she is not an "accident," rather an eternal verity, stands confessed in Mr. Allen's "almost." Unless, indeed, the entire community should be paired off—which is not desirable for economic reasons—spinsters and bachelors will continue to exist. It does not materially affect the issues of the race whether they are dependent or independent,[*] and we may fearlessly praise in them the qualities which please us most. If the condition of "self-supporting spinsterhood" is more attractive than the condition of wifehood, there is menace for the future.

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[*] Dr. Weir Mitchell, "Wear and Tear," p. 151.

[†] Report published at Boston, May, 1885.

[‡] Rumors of this kind are sometimes too readily circulated. "Serious case, that of Miss O.," said a prominent physician in a Western city; "she has returned from Vassar thoroughly overworked." "Who, Carrie O.?" exclaimed a young lady hearer. "O doctor, that isn't possible! She was the giddiest girl in our class, went to parties three or four nights in the week, never had a lesson, and so Miss M. dropped her. When she found she couldn't graduate, she went to Vassar as a special student, because, she said, 'it was so far away no one would know whether she stood high or not, and she didn't intend to study her eyes out.'" The doctor's countenance fell. One victim of "higher education" was crossed off the score.

[*] It is desirable that young women should support themselves for these reasons: (1) that they may be free to marry; (2) in case they fail of marriage; and (3) because sickness or accident to the husband may render a wife's support valuable.

It would be alarming, if we could believe with Mr. Allen in anything so unflattering to masculine endeavor; but, unfortunately, there are no statistics to prove whether this is due to dulled feminine instinct, or to the failure of man to make love at the right time. In the interim, from collateral evidence, the latter cause appears more trustworthy.

IV. If freedom from Mrs. Grundy is desirable, it is patent that education and independence are gradually liberating woman. The counter-charge is often made that the educated woman is too regardless of that favored deity.

From a biological point of view, Mr. Allen endows four years of college training with enormous potentiality. In this he evidently follows the eminent leader, Mr. Herbert Spencer, who asserts that the infertility of "upper-class girls" in England is due to "overtaxing of their brains"![*] Whether the majority of English "upper-class girls" are educated to that extreme point, and whether the question is not begged in the use of the word "overtaxation," may be left to the reader. It is strange that powerful heredity and palpable causes of race deterioration should be ignored by physiologists[†] in order to throw the *onus* of this accusation upon mental culture. Insurance tables are made out more scientifically than this forecast of a girl's future. If in education, or in the industrial independence of women, there existed any tendency toward infertility, it would be barely discoverable in our generation, little more so in the next, and possibly in the third generation something might be ascertained from careful statistics following Mr. Galton's method. Nature does not retrograde so rapidly. There is nothing to warrant the assumption that four years of altered food, training, or environment, not interfering with good physical condition, could obliterate an instinct or function. Investigation corroborates this. Even in England, we learn that infertility and higher education are not synonymous terms. A teacher of wide experience states:[‡] "I know several families of children whose mothers were among the pioneers of the movement now so savagely attacked. . . . Among my friends, not a few sturdy, handsome children, whose mothers underwent severe study in their earlier days. One of these was a lady who, with one other, was the first woman to take the classical tripos, and whose degree was not beaten, I think, for ten years." In America, in "a report given of the family conditions of one hundred and thirty alumnæ who have had children, the exceptional record of good health among these children, and their low death-rate, are strong evidences that the powers of motherhood have not suffered from college work."[*] In addition, the writer's mite of testimony may be offered. In the schools which she has attended,[†] the majority of earnest students were in uniformly good health; a minority were delicate before beginning study. The most frequent examples of ill health were found among those who made a pretense of study and eagerly pursued social excitements. Subsequent effect upon the health may be judged when it is found that twelve years after graduation one young woman, ranking at the head of her class, is the mother of six vigorous children; two others, earnest students, have each a family of five, and a number of others have four children. No correspondence has been held with married classmates living at a distance. These mentioned are personally known to be mothers in the fullest sense, and constitute striking contradictions to the claim that education has an injurious effect upon woman. "But," it may be objected, "these are exceptionally healthy women." Undoubtedly, but if the training has any influence at all, it should make them fall slightly below the standard of the preceding generation, whereas, in several instances, they improved upon the record of their mothers, not only in general health, but in the condition and size of their families.

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[*] "Principles of Biology."

[†] Similar premature judgment was given by the late Dr. E. H. Clarke, of Boston, in 1871, "Sex and Education." See also "Woman's Work in Creation," Dr. B. W. Richardson, "Longman's Magazine," October, 1886.

[‡] "Woman and Work," p. 116.

If, now, we review the discussion to this point, it may be summed up as follows:

I. Decrease of marriage results from a transition state in the condition of women, also from unjust laws and false social customs which discourage matrimony.

II. Able women generally are not dissatisfied with womanhood, and do not advocate celibacy. It is not evident that women of any class are *becoming unfitted* for motherhood, but women of the "cultivated classes" *are not* the best possible mothers. Independent and highly educated women are only a fraction among these, and can not be substituted for the whole.

III. The higher education of woman teaches her reverence for Nature; the development and control, *not* the suppression of natural instinct, therefore tends to make her the best wife and mother. The "spiritless epicene automaton" is mythical. The spinster is an eternal verity. The woman movement has not created her, but changed her condition from dependence to self-support.

IV. The education and independence of women is a step in emancipation even from Mrs. Grundy, but it can not be made responsible for the present infertility among women, for these reasons:

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[*] Report of "Health Committee, Association Collegiate Alumnæ," Annie G. Howes, 1885.

[†] Four schools for girls, one college for women, two universities for men and women.

First. It is too recent in effect, having barely reached the second generation. Second. There are more potent causes—heredity, race deterioration, and false marriage. Third. It actually produces healthy wives and mothers in the fullest sense.

There is no denial of the fact that too large a percentage of educated women,* as well as of the cultivated classes generally, remain unmarried. However, it has been shown in regard to the former, that "dulled instinct" is not a tenable cause. Some have attributed it more wisely to increased "nicety of choice." This may prove beneficial in the end, when man shall have become a more importunate suitor.

Women can no longer be coerced into marriage, nor will they marry from a sense of duty to humanity. But for these reasons there need be no fear that the race will perish. There is as much prospect that roses will refuse to bloom in June as that women will ever become invincible to love. This force, and this alone, can make of them light-hearted mothers in place of the weary wrecks whose perverted motherhood has been anything but a boon to humanity. As long as it is taught that motherhood oppresses woman physically and restricts her intellectually, so long the average woman may dread or rebel against it. When she studies it in all its conditioning, she finds it does not impose such a fate upon her. She learns to discriminate between the ordering of Nature and the blunders of mankind, and recognizes that normal physical development can not be antagonistic to mental growth.

If, as is known among the lower forms of life, there should be such evil fate in store for women as *parthenogenesis* or *polyembryony*, or any entire change of function or structure, it would be quite useless to rebel. Even such highly imaginary metamorphosis would not imply extinction of species. The causes of this calamity have not been fathomed by Darwin nor Weissman; and, if such disintegrating forces were at work among us, who would be wise enough to recognize them?

Study of nature leads us to believe that, if the individual be free and supplied with the means of life, there is great probability of the survival of his kind. However, we have seen that the human race decreases under artificial conditioning, and, if we are concerned lest man should become extinct, let us strive to live simply, naturally; neither separate nor antagonize the sexes; then there may be more need of Mr. Malthus than of any pessimistic prophecy on the danger of developing a woman's mind.

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* Highly educated women are yet a minority among women of the so-called "cultivated classes," and are better ranked with working women, since they agree with them more nearly in habits of life.

ON THE NATURAL INEQUALITY OF MEN.

BY PROF. T. H. HUXLEY, F.R.S.

THE political speculations set forth in Rousseau's "Discours sur l'origine de l'inégalité parmi les hommes," and in the more noted essay, "Du Contrat Social," which were published, the former in 1754 and the latter eight years later, are, for the most part, if not wholly, founded upon conceptions with the origination of which he had nothing to do. The political, like the religious, revolutionary movement of the eighteenth century in France came from England. Hobbes, primarily, and Locke, secondarily (Rousseau was acquainted with the writings of both), supplied every notion of fundamental importance which is to be found in the works which I have mentioned. But the skill of a master of the literary art and the fervor of a prophet combined to embellish and intensify the new presentation of old speculations; which had the further good fortune to address itself to a public as ripe and ready as Balak himself to accept the revelations of any seer whose prophecies were to its mind.

Missionaries, whether of philosophy or of religion, rarely make rapid way, unless their preachings fall in with the prepossessions of the multitude of shallow thinkers, or can be made to serve as a stalking-horse for the promotion of the practical aims of the still larger multitude, who do not profess to think much, but are quite certain they want a great deal. Rousseau's writings are so admirably adapted to touch both these classes that the effect they produced, especially in France, is easily intelligible. For, in the middle of the eighteenth century, French society (not perhaps so different as may be imagined from other societies before and since) presented two large groups of people who troubled themselves about politics—in any sense other than that of personal or party intrigue. There was an upper stratum of luxurious idlers, jealously excluded from political action and consequently ignorant of practical affairs, with no solid knowledge or firm principles of any sort; but, on the other hand, open-minded to every novelty which could be apprehended without too much trouble, and exquisitely appreciative of close deductive reasoning and clear exposition. Such a public naturally welcomed Rousseau's brilliant developments of plausible first principles by the help of that *a priori* method which saves so much troublesome investigation.*

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* In his famous work on "Ancient Law" the late Sir Henry Maine has remarked, with great justice, that Rousseau's philosophy "still possesses singular fascination for the looser thinkers of every country"; that "it helped most powerfully to bring about the grosser disappointments of which the first French Revolution was fertile," and that "it gave birth, or intense stimulus, to the vices of mental habit all but universal at the time, disdain of

It just suited the "philosophes," male and female, interchanging their airy epigrams in *salons*, which had about as much likeness to the Academy or to the Stoa, as the "philosophes" had to the philosophers of antiquity.

I do not forget the existence of men of the type of Montesquieu or D'Argenson in the France of the eighteenth century, when I take this as a fair representation of the enlightened public of that day. The unenlightened public, on the other hand, the people who were morally and physically debased by sheer hunger; or those, not so far dulled or infuriated by absolute want, who yet were maddened by the wrongs of every description inflicted upon them by a political system which, so far as its proper object, the welfare of the people, was concerned, was effete and powerless; the subjects of a government smitten with paralysis for everything but the working of iniquity and the generation of scandals; these naturally hailed with rapture the appearance of the teacher who clothed passion in the garb of philosophy; and preached the sweeping away of injustice by the perpetration of further injustice, as if it were nothing but the conversion of sound theory into practice.

It is true that any one who has looked below the surface* will hardly be disposed to join in the cry which is so often raised against the "philosophes" that their "infidel and leveling" principles brought about the French Revolution. People, like the Marquis d'Argenson, with political eyes in their heads, saw that the revolution was inevitable before Rousseau wrote a line. In truth, the Bull "Unigenitus," the interested restiveness of the Parliaments, and the extravagancies and profligacy of the court had a great deal more influence in generating the catastrophe than all the "philosophes" that ever put pen to paper. But, undoubtedly, Rousseau's extremely attractive and widely read writings did a great deal to give a color of rationality to those principles of '89 † which, even after the lapse of a century, are considered

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positive law, impatience of experience, and the preference of *a priori* to all other reasoning" (pp. 89–92). I shall often have to quote "Ancient Law." The first edition of this admirable book was published in 1861, but now, after eighteen years of growing influence on thoughtful men, it seems to be forgotten, or willfully ignored, by the ruck of political speculators. It is enough to make one despair of the future that Demos and the Bourbons seem to be much alike in their want of capacity for either learning or forgetting.

* Those who desire to do so with ease and pleasure should read M. Rocquain's "L'esprit révolutionnaire en France avant la Révolution." It is really a luminous book, which ought to be translated for the benefit of our rising public men, who, having had the advantage of a public-school education, are so often unable to read French with comfort. For deeper students there is, of course, the great work of M. Taine, "Les origines de la France contemporaine."

† Sir H. Maine observes that the "strictly judicial axiom" of the lawyers of the Antonine era ("omnes homines naturâ æquales sunt"—all men are by nature equal), after passing through the hands of Rousseau, and being adopted by the founders of the Constitution

by a good many people to be the Magna Charta of the human race. "Liberty, Equality, and Fraternity," is still the war-cry of those, and they are many, who think, with Rousseau, that human sufferings must needs be the consequence of the artificial arrangements of society, and can all be alleviated or removed by political changes.

The intellectual impulse which may thus be fairly enough connected with the name of the Genevese dreamer has by no means spent itself in the century and a half which has elapsed since it was given. On the contrary, after a period of comparative obscurity (at least outside France), Rousseauism has gradually come to the front again, and at present promises to exert once more a very grave influence on practical life. The two essays to which I have referred are, to all appearance, very little known to the present generation of those who have followed in Rousseau's track. None the less is it true that his teachings, filtered through innumerable channels and passing under other names, are still regarded as the foundations of political science by the existing representatives of the classes who were so much attracted by them when they were put forth. My friend Mr. John Morley, who probably knows more about Rousseau and his school than anybody else,[*] must have been entertained (so far as amusement is possible to the subject of the process of "heckling") when Rousseau's *plats*, the indigestibility of which he exposed so many years ago, were set before him as a wholesome British dish; the situation had a certain piquancy, which no one would appreciate more keenly.

I happened to be very much occupied upon subjects of a totally different character, and had no mind to leave them, when the narrative of this occurrence and some letters to which it gave rise, appeared in the "Times." But I have very long entertained the conviction that the revived Rousseauism of our day is working sad mischief, leading astray those who have not the time, even when they possess the ability, to go to the root of the superficially plausible doctrines which are disseminated among them. And I thought it was my duty to see whether some thirty years' training in the art of making difficult questions intelligible to audiences without much learning, but with that abundance of keen practical sense which characterizes English workmen of the better class,

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of the United States, returned to France endowed with vastly greater energy and dignity, and that "of all 'the principles of 1789' it is the one which has been least strenuously assailed, which has most thoroughly leavened modern opinion, and which promises to modify most deeply the constitution of societies, and the politics of states" ("Ancient Law," p. 96).

[*] If I had not reason to think that Mr. Morley's "Rousseau," and Sir Henry Maine's "Ancient Law," especially the admirable Chapters III and IV, must be unknown to many political writers and speakers, and *a fortiori* to the general public, there would be no excuse for the present essay, which simply restates the case which they have so exhaustively treated.

would enable me to do something toward the counteraction of the fallacious guidance which is offered to them. Perhaps I may be permitted to add that the subject was by no means new to me. Very curious cases of communal organization and difficult questions involving the whole subject of the rights of property come before those whose duty it is to acquaint themselves with the condition of either sea or fresh-water fisheries, or with the administration of fishery laws. For a number of years it was my fate to discharge such duties to the best of my ability; and, in doing so, I was brought face to face with the problem of land-ownership and the difficulties which arise out of the conflicting claims of commoners and owners in severalty. And I had good reason to know that mistaken theories on these subjects are very liable to be translated into illegal actions. I can not say whether the letters which I wrote in any degree attained the object (of vastly greater importance, to my mind, than any personal question) which I had in view. But I was quite aware, whatever their other results, they would probably involve me in disagreeable consequences; and, among the rest, in the necessity of proving a variety of statements, which I could only adumbrate within the compass of the space that the "Times" could afford me, liberal as the editor showed himself to be in that respect. What I purpose to do in the course of the present article, then, is to make good these shortcomings; to show what Rousseau's doctrines were, and to inquire into their scientific value—with, I hope, that impartiality which it beseems us to exhibit in inquiries into ancient history. Having done this, I propose to leave the application of the conclusions at which I arrive to the intelligence of my readers, as I shall thus escape collision with several of my respected contemporaries.*

I have indicated two sources from which our knowledge of Rousseau's system may be derived, and it is not worth while to go any further. But it is needful to observe that the dicta of the author of the "Contrat Social," published in 1762, are not unfrequently very hard—indeed, I might say impossible—to reconcile with those of the author of the "Discours," which appeared eight years earlier; and that, if any one should maintain that the older essay was not meant to be taken seriously, or that it has been, in some respects, more or less set aside by the later, he might find strong grounds for his opinion. It is enough for me that the same *a priori* method and the same fallacious assumptions pervade both.

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* From Mr. Herbert Spencer's letter in the "Times" of November 27, 1889, I gather that he altogether repudiates the doctrines which I am about to criticise. I rejoice to hear it: in the first place, because they thus lose the shelter of his high authority; secondly, because, after this repudiation, anything I may say in the course of the following pages against Rousseauism can not be disagreeable to him; and, thirdly, because I desire to express my great regret that, in however good company, I should have lacked the intelligence to perceive that Mr. Spencer had previously repudiated the views attributed to him by the land socialists. May I take this opportunity of informing the many correspondents who usually favor me with comments (mostly adverse, I am sorry to say) on what I venture to write, that I have no other answer to give them but Pilate's, "What I have written I have written"? I have no energy to waste on replies to irresponsible criticism.

The thesis of the earlier work is that man, in the "state of nature," was a very excellent creature indeed, strong, healthy, good, and contented; and all the evils which have befallen him, such as feebleness, sickness, wickedness, and misery, result from his having forsaken the "state of nature" for the "state of civilization." And the first step in this downward progress was the setting up of rights of several property. It might seem to a plain man that the argument here turns on a matter of fact: if it is not historically true that men were once in this "state of nature"—what becomes of it all? However, Rousseau tells us, in the preface to the "Discours," not only that the "state of nature" is something which no longer exists, but that "perhaps it never existed, and probably never will exist." Yet it is something "of which it is nevertheless necessary to have accurate notions in order to judge our present conditions rightly." After making this singular statement, Rousseau goes on to observe: "Il faudrait même plus de philosophie qu'on ne pense à celui qui entreprendrait de déterminer exactement les précautions à prendre pour faire sur ce sujet de solides observations." (More philosophy indeed is needed than one thinks for him who undertakes to determine exactly the precautions to be taken to make solid observations on this subject.) And, certainly, the amount of philosophy required to base an argument on that which does not exist, has not existed, and perhaps never will exist, may well seem unattainable—at any rate, at first sight. Yet, apart from analogies which might be drawn from the mathematical sciences—where, for example, a straight line is a thing which has not existed, does not exist, and probably never will exist, and yet forms a good ground for reasoning; and the value of which I need not stop to discuss—I take it that Rousseau has a very comprehensible idea at the bottom of this troublesome statement. What I conceive him to mean is that it is possible to form an ideal conception of what ought to be the condition of mankind;* and that, having done so, we are bound to judge the existing state of things by that ideal. That assumption puts us on the "high *priori* road" at once.

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* Compare "Ancient Law": "The Law of Nature confused the Past and the Present. Logically, it implied a state of Nature which had once been regulated by Natural Law; yet the jurisconsults do not speak clearly or confidently of the existence of such a state" (p. 73). "There are some writers on the subject who attempt to evade the fundamental difficulty by contending that the code of Nature exists in the future and is the goal to which all civil laws are moving" (p. 74). The jurisconsults conceived of Natural Law "as a system which ought gradually to absorb Civil Laws" (p. 76). "Its functions were, in short, remedial, not revolutionary or anarchical. And this unfortunately is the exact point

I do not suppose that any one is inclined to doubt the usefulness of a political ideal as a goal toward which social conduct should strive, whether it can ever be completely realized or not; any more than any one will doubt that it is useful to have a moral ideal toward which personal conduct should tend, even though one may never reach it. Certainly, I am the last person to question this, or to doubt that politics is as susceptible of treatment by scientific method as any other field of natural knowledge.* But it will be admitted that, great as are the advantages of having a political ideal, fashioned by an absolute rule of political conduct, it is perhaps better to do without one, rather than to adopt the first phantasm, bred of fallacious reasonings and born of the unscientific imagination, which presents itself. The benighted traveler, lost on a moor, who refuses to follow a man with a lantern, is surely not to be commended. But suppose his hesitation arises from a well-grounded doubt as to whether the seeming luminary is anything but a will o' the wisp? And, unless I fail egregiously in attaining my purpose, those who read this paper to the end will, I think, have no doubt that the political lantern of Rousseauism is a mere corpse-candle and will plunge those who follow it in the deepest of anarchic bogs.

There is another point which must be carefully borne in mind in any discussion of Rousseau's doctrines; and that is the meaning which he attaches to the word "inequality." A hundred and fifty years ago, as now, political and biological philosophers found they were natural allies.† Rousseau is not intelligible without Buffon, with whose earlier works he was evidently acquainted, and whose influence in the following passage is obvious:

> It is easy to see that we must seek the primary cause of the differences by which men are distinguished in these successive changes of the human constitution; since it is universally admitted that they are, naturally, as equal among

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at which the modern view of a Law of Nature has often ceased to resemble the ancient" (p. 77).

* In the course of the correspondence in the "Times" to which I have referred, I was earnestly exhorted to believe that the world of politics does not lie outside of the province of science. My impression is that I was trying to teach the public that great truth, which I had learned from Mill and Comte, thirty-five years ago; when, if I mistake not, my well-meaning monitor was more occupied with peg-tops than with politics. See a lecture on the "Educational Value of the Natural History Sciences" delivered in 1854 ("Lay Sermons," p. 97).

† The publication of Buffon's "Histoire Naturelle" began in 1749. Thus Rousseau was indebted to the naturalists; on the other hand, in the case of the elder Darwin, who started what is now usually known as Lamarck's hypothesis, the naturalist was set speculating by the ideas of the philosopher Hartley, transmitted through Priestley. See "Zoonomia," I, sect. xxxix, p. 483 (ed. 1796). I hope some day to deal at length with this curious fact in scientific history.

> themselves as were the animals of each species before various physical causes had produced, in some of them, the varieties which we observe. In fact, it is not conceivable that these first changes, by whatever means they were brought about, altered, at once and in the same way, all the individuals of a species; but some having become improved or deteriorated, and having acquired different qualities, good or bad, which were not inherent in their nature, the others remained longer in their original state; and such was the first source of inequality among men, which is more easy to prove thus, in a general way, than to assign exactly to its true causes. ("Discours," preface.)

In accordance with this conception of the origin of inequality among men, Rousseau distinguishes, at the outset of the "Discours," two kinds of inequality:

> the one which I term *natural*, or *physical*, because it is established by nature, and which consists in the differences of age, health, bodily strength, and intellectual or spiritual qualities; the other, which may be called *moral*, or *political*, because it depends on a sort of convention, and is established, or at least authorized, by the consent of mankind. This last inequality consists in the different privileges which some enjoy, to the prejudice of others, as being richer, more honored, more powerful than they, or by making themselves obeyed by others.

Of course the question readily suggests itself: Before drawing this sharp line of demarkation between natural and political inequality, might it not be as well to inquire whether they are not intimately connected, in such a manner that the latter is essentially a consequence of the former? This question is indeed put by Rousseau himself. And, as the only answer he has to give is a piece of silly and insincere rhetoric about its being a question fit only for slaves to discuss in presence of their masters, we may fairly conclude that he knew well enough he dare not grapple with it. The only safe course for him was to go by on the other side and as far as the breadth of the road would permit; and, in the rest of his writings, to play fast and loose with the two senses of inequality, as convenience might dictate.

With these preliminary remarks kept well in view, we may proceed to the discussion of those fundamental theses of the "Discourse" and of the "Social Contract" which Rousseau calls the "principes du droit politique." Rousseau defines his object thus:

> Je veux chercher si dans l'ordre civil il peut y avoir quelque règle d'administration légitime et sûre, en prenant les hommes tels qu'ils sont et les lois tels qu'elles peuvent être. Je tâcherai d'allier toujours dans cette recherche ce que le droit permet avec ce que l'intérêt prescrit, afin que la justice et l'utilité ne se trouvent point divisées.[*] (I seek to know if there may be in the civil order any legitimate and sure rule of civil administration, taking men as they are and laws as they might be. I shall try to combine in this research what the law permits with what interest prescribes, so that justice and utility shall not find themselves divided.)

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[*] "Contrat Social," livre 1er. Compare Hobbes's dedication of "Human Nature" written in 1640: "They who have written of justice and policy in general do all invade each other

In other words, our philosopher propounds "sure," that is "absolute," principles which are, at once ethically and politically, sufficient rules of conduct, and that I understand to be the precise object of all who have followed in his track. It was said of the Genevese theorist, "Le genre humain avait perdu ses titres; Jean-Jacques les a retrouvés" (the human race had lost its title-deeds; Jean-Jacques found them again); just as his intellectual progeny declare that the nation ought to "resume" the landed property of which it has, unfortunately, lost the title-deeds.

We are now in a position to consider what the chief of these principles of the gospel according to Jean-Jacques are:

1. All men are born free, politically equal, and good, and in the "state of nature" remain so; consequently it is their natural right to be free, equal, and (presumably, their duty to be) good.*

2. All men being equal by natural right, none can have any right to encroach on another's equal right. Hence no man can appropriate any part of the common means of subsistence—that is to say, the land or anything which the land produces—without the unanimous consent of all other men. Under any other circumstances, property is usurpation, or, in plain terms, robbery.†

3. Political rights, therefore, are based upon contract; the so-called right of conquest is no right, and property which has been acquired by force may rightfully be taken away by force.‡

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and themselves with contradictions. To reduce this doctrine to the rules and infallibility of reason there is no way, but, first, put such principles down for a foundation, as passion, not mistrusting, may not seek to displace; and afterward to build thereon the truth of cases in the law of nature (which hitherto have been built in the air) by degrees, till the whole have been inexpugnable." However, it must be recollected that Hobbes does not start from *a priori* principles of ethics, but from the practical necessities of men in society.

* "Contrat Social," v, pp. 98, 99. The references here given are to the volumes and pages of Mussay Pathay's edition (1826). "Discours," *passim*; see especially p. 268.

† "Discours," pp. 257, 258–276. How many wild sermons have been preached on this text: "Ignorez-vous qu'une multitude de vos frères périt ou souffre du besoin de ce que vous avez de trop, et qu'il vous fallait un consentement exprès et unanime du genre humain pour vous approprier sur la subsistance commune tout ce qui alloit au-delà de la vôtre?" (Don't you know that a multitude of your brothers are perishing or suffering for the need of what you have too much of, and that you ought to have an express and unanimous consent of the human race before you appropriate to yourself from the common subsistence any more than you need for your own?)

‡ "Discours," pp. 276, 280; "Contrat," chap. iii.: "Telle fut ou dut être" (charming alternative!) "l'origine de la société et des lois, qui donnèrent de nouvelles entraves au foible et de nouvelles forces au riche, détruisirent sans retour la liberté naturelle, fixèrent pour jamais la loi de la propriété et de l'inégalité, d'une adroite usurpation firent un droit irrévocable, et, pour le profit de quelques ambitieux, assujettirent désormais tout le genre humain au travail, à la servitude et à la misère." (Such was or must have been the origin of society and of the laws which imposed new shackles on the weak man and gave new forces to the rich one, destroyed natural liberty without requital, established forever the law of property and inequality, made an irrevocable law of an adroit usurpation, and

I am bound to confess, at the outset, that, while quite open to conviction, I incline to think that the obvious practical consequences of these propositions are not likely to conduce to the welfare of society, and that they are certain to prove as injurious to the poor as to the rich. Due allowance must be made for the possible influence of such prejudice as may flow from this opinion upon my further conviction that, regarded from a purely theoretical and scientific point of view, they are so plainly and demonstrably false that, except for the gravity of their practical consequences, they would be ridiculous.

What is the meaning of the famous phrase that "all men are born free and equal,"* which gallicized Americans, who were as much "philosophes" as their inherited common sense and their practical acquaintance with men and with affairs would let them be, put forth as the foundation of the "Declaration of Independence"? I have seen a considerable number of new-born infants. Without wishing to speak of them with the least disrespect—a thing no man can do, without, as the proverb says, "fouling his own nest"—I fail to understand how they can be affirmed to have any political qualities at all. How can it be said that these poor little mortals who have not even the capacity to kick to any definite end, nor indeed to do anything but vaguely squirm and squall, are equal politically, except as all zeros may be said to be equal? How can little creatures be said to be "free" of whom not one would live for four-and-twenty hours if it were not imprisoned by kindly hands and coerced into applying its foolish, wandering mouth to the breast it could never find for itself? How is the being whose brain is still too pulpy to hold an idea of any description to be a moral agent either good or bad? Surely it must be a joke, and rather a cynical one too, to talk of the political status of a new-born child! But we may carry our questions a step further. If it is mere abracadabra to speak of men being born in a state of political freedom and equality, thus fallaciously confusing positive equality—that is to say, the equality of powers—with the equality of impotences; in what conceivable state of society is it possible that men should not merely be born, but pass through childhood and still remain free? Has a child of fourteen been free to choose its language and all the connotations with which words became burdened in their use by generation after generation? Has it been free to choose the habits enforced by precept and more surely driven home by example? Has it been free to invent its own standard of right and wrong? Or rather,

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henceforth, for the profit of a few ambitious persons, subjected the whole human race to labor, servitude, and misery.)—("Discours," p. 278). Behold the quintessence of Rousseauism—method and results—with practical application, legible by the swiftest runner!

* ["All men are created equal" is the wording of the "Declaration."—Editor P. S. M.]

has it not been as much held in bondage by its surroundings and driven hither and thither by the scourge of opinion, as a veritable slave, although the fetters and the whip may be invisible and intangible?

Surely, Aristotle was much nearer the truth in this matter than Hobbes or Rousseau. And if the predicate "born slave" would more nearly agree with fact than "born free," what is to be said about "born equal"? Rousseau, like the sentimental rhetorician that he was, and half, or more than half, sham, as all sentimental rhetoricians are, sagaciously fought shy, as we have seen, of the question of the influence of natural upon political equality. But those ~~of us~~ who do not care for sentiment and do care for truth may not evade the consideration of that which is really the key of the position. If Rousseau, instead of letting his children go to the *infants trouvés*, had taken the trouble to discharge a father's duties toward them, he would hardly have talked so fast about men being born equal, even in a political sense. For, if that merely means that all new-born children are political zeros—it is, as we have seen, though true enough, nothing to the purpose; while, if it means that, in their potentiality of becoming factors in any social organization—citizens in Rousseau's sense—all men are born equal, it is probably the most astounding falsity that ever was put forth by a political speculator; and that, as all students of political speculation will agree, is saying a good deal for it. In fact, nothing is more remarkable than the wide inequality which children, even of the same family, exhibit, as soon as the mental and moral qualities begin to manifest themselves; which is earlier than most people fancy. Every family spontaneously becomes a polity. Among the children, there are some who continue to be "more honored and more powerful than the rest, and to make themselves obeyed" (sometimes, indeed, by their elders) in virtue of nothing but their moral and mental qualities. Here "political inequality" visibly dogs the heels of "natural" inequality. The group of children becomes a political body, a *civitas*, with its rights of property, and its practical distinctions of rank and power. And all this comes about neither by force nor by fraud, but as the necessary consequence of the innate inequalities of capability.

Thus men are certainly not born free and equal in natural qualities; when they are born, the predicates "free" and "equal" in the political sense are not applicable to them; and as they develop, year by year, the differences in the political potentialities with which they really are born, become more and more obviously converted into actual differences—the inequality of political faculty shows itself to be a necessary consequence of the inequality of natural faculty. It is probably true that the earliest men were nomads. But among a body of naked, wandering savages, though there may be no verbally recognized distinctions of rank or office, superior strength and cunning confer authority of a more valid kind than that secured by acts of Parliament; there may be no property in things, but the witless man will be poverty-stricken in ideas, the clever man will be a capitalist in that same commodity, which in the long run buys all other commodities; one will miss opportunities, the others will make them; and, proclaim human equality as loudly as you like, Witless will serve his brother. So long as men are men and society is society, human equality will be a dream; and the assumption that it does exist is as untrue in fact as it sets the mark of impracticability on every theory of what ought to be, which starts from it.

And that last remark suggests that there is another way of regarding Rousseau's speculations. It may be pointed out that, after all, whatever estimate we may form of him, the author of works which have made such a noise in the world could not have been a mere fool; and that if, in their plain and obvious sense, the doctrines which he advanced are so easily upset, it is probable that he had in his mind something which is different from that sense.

I am a good deal disposed to think that this is the case. There is much to be said in favor of the view that Rousseau, having got hold of a plausible hypothesis, more or less unconsciously made up a clothing of imaginary facts to hide its real nakedness. He was not the first nor the last philosopher to perform this feat.

As soon as men began to think about political problems, it must have struck them that, if the main object of society was the welfare of its members (and until this became clear, political action could not have risen above the level of instinct),* there were all sorts of distinctions among men, and burdens laid upon them, which nowise contributed to that end. Even before the great leveler, Rome, had actually thrown down innumerable social and national party-walls, had absorbed all other forms of citizenship into her own, and brought the inhabitants of what was then known as the world under one system of obligations—thoughtful

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* It is not to be forgotten that what we call rational grounds for our beliefs are often extremely irrational attempts to justify our instincts. I can not doubt that human society existed before language or any ethical consciousness. Gregarious animals form polities in which they act according to rules conducive to the welfare of the whole society, although, of course, it would be absurd to say that they obey laws in the juridical sense. The polities of the masterless dogs in Eastern cities are well known. And, in any street of an English town, one may observe a small dog chased by a bigger, who turns round the moment he has entered his own territory and defies the other; while, usually, after various manifestations of anger and contempt, the bigger withdraws. No doubt the small dog has had previous experience of the arrival of assistance under such circumstances, and the big one of the effects of sticks and stones and other odd missiles; no doubt the associations thus ingrained are the prime source of the practical acknowledgment of ownership on both sides. I suspect it has been very much the same among men.

men were discovering that it was desirable, in the interest of society, that all men should be as free as possible, consistently with those interests; and that they should all be equally bound by the ethical and legal obligations which are essential to social existence. It will be observed that this conclusion is one which might be arrived at by observation and induction from the phenomena of past and present experience. My belief is that it is the conclusion which must be reached by those means, when they are rightly employed—and that, in point of fact, the doctrines of freedom and equality, so far as they were preached by the Stoics and others, would have not the least success, if they had not been so far approved by experience and so far in harmony with human instincts that the Roman jurists found they could work them up with effect into practical legislation. For the *a priori* arguments of the philosophers in the last century of the republic, and the first of the empire, stand examination no better than those of the philosophers in the centuries before and after the French Revolution. As is the fashion of speculators, they scorned to remain on the safe if humble ground of experience, and preferred to prophesy from the sublime cloud-land of the *a priori;* so that, busied with deduction from their ideal "ought to be," they overlooked the "what has been," the "what is," and the "what can be."

It is to them that we owe the idea of living "according to nature"; which begot the idea of the "state of nature"; which begot the notion that the "state of nature" was a reality, and that, once upon a time, "all men were free and equal"—which again begot the theory that society ought to be reformed in such a manner as to bring back these halcyon days of freedom and equality; which begot *laissez faire* and universal suffrage; which begot the theory so dear to young men of more ambition than industry, that while every other trade, business, or profession requires theoretical training and practical skill, and would go to the dogs if those who carry them on were appointed by the majority of votes of people who know nothing about it and very little about them—the management of the affairs of society will be perfectly successful if only the people who may be trusted to know nothing will vote into office the people who may be trusted to do nothing.

If this is the political ideal of the modern followers of Rousseau, I, for my part, object to strive after it, or to do anything but oppose, to the best of my ability, those who would fain drive us that way. Freedom, used foolishly, and equality, asserted in words, but every moment denied by the facts of nature, are things of which, as it seems to me, we have rather too much already. If I mistake not, one thing we need to learn is the necessity of limiting individual freedom for the general good; and another, that although decision by a majority of votes may be as good a rough-

and-ready way as can be devised to get political questions settled, yet that, theoretically, the despotism of a majority is as little justifiable and as dangerous as that of one man; and yet another, that voting power, as a means of giving effect to opinion, is more likely to prove a curse than a blessing to the voters, unless that opinion is the result of a sound judgment operating upon sound knowledge. Some experience of sea-life leads me to think that I should be very sorry to find myself on board a ship in which the voices of the cook and the loblolly boys counted for as much as those of the officers, upon a question of steering, or reefing topsails; or where the "great heart" of the crew was called upon to settle the ship's course. And there is no sea more dangerous than the ocean of practical politics—none in which there is more need of good pilotage and of a single, unfaltering purpose when the waves rise high.

The conclusion of the whole matter, then, would seem to be that the doctrine that all men are, in any sense, or have been, at any time, free and equal, is an utterly baseless fiction. Nor does the proposition fare much better if we modify it, so as to say that all men ought to be free and equal, so long as the "ought" poses as a command of immutable morality. For, assuredly, it is not intuitively certain "that all men ought to be free and equal." Therefore, if it is to be justified at all *a priori*, it must be deducible from some proposition which is intuitively certain; and unfortunately none is forthcoming. For the proposition that men ought to be free to do what they please, so long as they do not infringe on the equal rights of other men, assumes that men have equal rights and can not be used to prove that assumption. And if, instead of appealing to philosophy, we turn to revealed religion, I am not aware that either Judaism or Christianity affirms the political freedom or the political equality of men in Rousseau's sense. They affirm the equality of men before God—but that is an equality either of insignificance or of imperfection.

With the demonstration that men are not all equal under whatever aspect they are contemplated, and that the assumption that they ought to be considered equal has no sort of *a priori* foundation—however much it may, in reference to positive law, with due limitations, be justifiable by considerations of practical expediency—the bottom of Rousseau's argument, from *a priori* ethical assumptions to the denial of the right of an individual to hold private property, falls out. For Rousseau, with more logical consistency than some of those who have come after him, puts the land and its produce upon the same footing. "Vous êtes perdus si vous oubliez que les fruits sont à tous, et que la terre n'est à personne," says he. (You are lost if you forget that the fruits are for all and the land is not for any one.)

From Rousseau's point of view, this is, in fact, the only rational conclusion from the premises. The attempt to draw a distinction between land, as a limited commodity, and other things as unlimited, is an obvious fallacy. For, according to him,* the total habitable surface of the earth is the property of the whole human race in common. Undoubtedly, the habitable and cultivable land amounts to a definite number of square miles, which, by no effort of human ingenuity, at present known or suspected, can be sensibly increased beyond the area of that part of the globe which is not covered by water; and therefore its quantity is limited. But if the land is limited, so is the quantity of the trees that will grow on it; of the cattle that can be pastured on it; of the crops that can be raised from it; of the minerals that can be dug from it; of the wind; and of the water-power, afforded by the limited streams which flow from the limited heights. And, if the human race were to go on increasing in number at its present rate, a time would come when there would not be standing-ground for any more; if it were not that, long before that time, they would have eaten up the limited quantity of food-stuffs and died like the locusts that have consumed everything eatable in an oasis of the desert. The attempt to draw a distinction between land as limited in quantity, in the sense, I suppose, that it is something that can not be imported—and other things as unlimited, because they can be imported—has arisen from the fact that Rousseau's modern followers entertain the delusion that, consistently with their principles, it is possible to suppose that a nation has right of ownership in the land it occupies. If the island of Great Britain is the property of the British nation, then, of course, it is true that they can not have more than somewhere about ninety thousand square miles of land, while the quantity of other things they can import is (for the present, at any rate), practically, if not strictly, unlimited. But how is the assumption that the Britons own Britain, to be reconciled with the great dictum of Rousseau, that a man can not rightfully appropriate any part of this limited commodity, land, without the unanimous consent of all his fellow-men? My strong impression is that if a party-colored *plébiscite* of Europeans, Chinese, Hindoos, negroes, red Indians, Maoris, and all the other inhabitants of the terrestrial globe were to decree us to be usurpers, not a soul would budge; and that, if it came to fighting, Mr. Morley's late "hecklers" might be safely depended upon to hold their native soil against all intruders, and in the teeth of the most absolute of ethical politicians, even though he should prove from Rousseau—

> Exceedingly well
> That such conduct was quite atrocious.

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* As to Hobbes, but on different grounds.

Rousseau's first and second great doctrines having thus collapsed, what is to be said to the third?

Of course, if there are no rights of property but those based on contract, conquest, that is to say, taking possession by force, of itself can confer no right. But, as the doctrine that there are no rights of property but those based on the consent of the whole human race—that is, that A. B. can not own anything unless the whole of mankind formally signify their assent to his ownership—turns out to be more than doubtful in theory and decidedly inconvenient in practice, we may inquire if there is any better reason for the assertion that force can confer no right of ownership. Suppose that, in the old seafaring days, a pirate attacked an East Indiaman—got soundly beaten and had to surrender. When the pirates had walked the plank or been hanged, had the captain and crew of the East Indiaman no right of property in the prize—I am not speaking of mere legal right, but ethically? But if they had, what is the difference when nations attack one another; when there is no way out of their quarrel but the appeal to force, and the one that gets the better seizes more or less of the other's territory and demands it as the price of peace? In the latter case, in fact, we have a contract, a price paid for an article—to wit, peace—delivered, and certain lands taken in exchange; and there can be no question that the buyer's title is based on contract. Even in the former alternative, I see little difference. When they declared war, the parties knew very well that they referred their case to the arbitrament of force; and if contracts are eternally valid, they are fully bound to abide by the decision of the arbitrator whom they have elected to obey. Therefore, even on Hobbes's or Rousseau's principles, it is not by any means clear to my mind that force, or rather the state of express or tacit contract which follows upon force successfully applied, may not be plausibly considered to confer ownership.

But if the question is argued, as I think it ought to be, on empirical grounds—if the real question is not one of imagined *a priori* principle, but of practical expediency—of the conduct which conduces most to human welfare—then it appears to me that there is much to be said for the opinion that force effectually and thoroughly used, so as to render further opposition hopeless, establishes an ownership* which should be recognized as soon as possible. I am greatly disposed to think, that when ownership established by force has endured for many generations, and all sorts of contracts have been entered into on the faith of such ownership, the attempt to disturb it is very much to be deprecated on all grounds. For the welfare of society, as for that of individual men, it is surely essential that there should be a statute of limitations in respect of the consequences of wrong-doing. As there is nothing more fatal to nobility of personal character than the nursing of the feeling of revenge—nothing that more clearly indicates a barbarous state of society than the carrying on of a *vendetta*, generation after generation—so I take it to be a plain maxim of that political ethic which does not profess to have any greater authority than agreeableness to good feeling and good sense can confer, that the evil deeds of former generations—especially if they were in accordance with the practices of a less advanced civilization, and had the sanction of a less refined morality—should, as speedily as possible, be forgotten and buried under better things.

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* Submission to the Revolution of 1688 by Jacobites could be advocated ethically on no other ground, though all sorts of pretexts were invented to disguise the fact.

"Musst immer thun wie neu geboren" (must ever do as if new-born) is the best of all maxims for the guidance of the life of states, no less than of individuals. However, I express what I personally think, in all humility, in the face of the too patent fact that there are persons of light and leading—with a political authority to which I can make not the remotest pretension, and with a weight of political responsibility which I rejoice to think can never rest on my shoulders—who by no means share my opinion, but who, on the contrary, deem it right to fan the sparks of revenge which linger among the embers of ancient discords; and to stand between the dead past and the living present, not with the healing purpose of the Jewish leader, but rather to intensify the plague of political strife, and hold aloft the brazen image of the father's wrongs, lest the children might perchance forget and forgive.

However, the question whether the fact that property in land was originally acquired by force invalidates all subsequent dealings in that property so completely, that no lapse of time, no formal legalization, no passing from hand to hand by free contract through an endless series of owners, can extinguish the right of the nation to take it away by force from the latest proprietor, has rather an academic than a practical interest, so long as the evidence that landed ownership did so arise is wanting. Potent an organon as the *a priori* method may be, its employment in the region of history has rarely been found to yield satisfactory results; and, in this particular case, the confident assertions that land was originally held in common by the whole nation, and that it has been converted into severalty by force, as the outcome of the military spirit rather than by the consent, or contract, characteristic of industrialism, are singularly ill-founded.

Let us see what genuine history has to say to these assertions. Perhaps it might have been pardonable in Rousseau to propound such a statement as that the primitive land-owner was either a robber or a cheat; but, in the course of the century and a half which has elapsed since he wrote, and especially in that of the last fifty years, an immense amount of information on the subject of ancient land-tenure has come to light; so that it is no longer pardonable, in any one, to content himself with Rousseau's ignorance. Even a superficial glance over the results of modern investigations into anthropology, archæology, ancient law, and ancient religion, suffices to show that there is not a particle of evidence that men ever existed in Rousseau's state of nature, and that there are very strong reasons for thinking that they never could have done so, and never will do so.

It is, at the least, highly probable that the nomadic preceded any other social state; and, as the needs of a wandering hunter's or pastor's life are far more simple than any other, it follows that the inequalities of condition must be less obvious among nomads than among settled people. Men who have no costume at all, for example, can not be said to be unequally clothed; they are, doubtless, more equal than men some of whom are well clothed and others in rags, though the equality is of the negative sort. But it is a profound mistake to imagine that, in the nomadic condition, any more than in any other which has yet been observed, men are either "free" or "equal" in Rousseau's sense. I can call to mind no nomadic nation in which women are on an equality with men; nor any in which young men are on the same footing as old men; nor any in which family groups, bound together by blood ties, by their mutual responsibility for bloodshed and by common worship, do not constitute corporate political units, in the sense of the city[*] of the Greeks and Romans. A "state of nature" in which noble and peaceful, but nude and propertyless, savages sit in solitary meditation under trees, unless they are dining or amusing themselves in other ways, without cares or responsibilities of any sort, is simply another figment of the unscientific imagination. The only uncivilized men of whom anything is really known are hampered by superstitions and enslaved by conventions, as strange as those of the most artificial societies, to an almost incredible degree. Furthermore, I think, it may be said with much confidence that the primitive "land-grabber" did not either force or cheat his co-proprietors into letting him fence in a bit of the land which hitherto was the property of all.

The truth is, we do not know, and probably never shall know completely, the nature of all the various processes by which the ownership of land was originally brought about. But there is

[*] I may remind the reader that, in their original senses, πόλις and *civitas* mean, not an aggregation of houses, but a corporation. In this sense, the City of London is formed by the freemen of the city, with their common councilors, aldermen, and lord mayor.

excellent ground for sundry probable conclusions* in the fact that almost all parts of the world, and almost all nations, have yielded evidence that, in the earliest settled condition we can get at, land was held as private or several property, and not as the property of the public, or general body of the nation. Now private or several property may be held in one of two ways. The ownership may be vested in a single individual person, in the ordinary sense of that word; or it may be vested in two or more individuals forming a corporation or legal person; that is to say, an entity which has all the duties and responsibilities of an individual person, but is composed of two or more individuals. It is obvious that all the arguments which Rousseau uses against individual land-ownership apply to corporate land-ownership. If the rights of A, B, and C are individually *nil*, you can not make any more of your 0 by multiplying it by 3. (A, B, C)—the corporation—must be a usurper if A, B, and C, taken each by himself, is so. Moreover, I think I may take it for granted that those who desire to make the state universal land-owner would eject a corporation from its estates with even less hesitation than they would expel an individual.

The particular method of early land-holding of which we have the most wide-spread traces is that in which each of a great number of moderate-sized portions of the whole territory occupied by a nation is held in complete and inalienable ownership† by the males of a family, or of a small number of actual or supposed kindred families, mutually responsible in blood feuds, and worshiping the same God or Gods. No female had any share in the ownership of the land. If she married outside the community, she might take a share of the movables; and, as a rule, she went to her husband's community. If, however, the community was short of hands, the husband might be taken into it, and then he acquired all the rights and responsibilities of the other members. Children born in the community became full members of it by domicile, so to speak, not by heredity from their parents. This primitive "city" was lodged in one or more dwellings, each usually standing in a patch of inclosed ground; of arable land in the immediate neighborhood of the dwellings; while pasture and uncleared forest land lay outside all. Each commune was as jealous of its rights of ownership as the touchiest of squires; but, so long as the population was as scanty in proportion to the occupied territory as was usually the case in ancient times, the communities got along pretty peaceably with one another. Any notion that all the communities which made up the nation had a sort of corporate overlordship over any one, still more that all the rest of the world had any right to complain of their "appropriation of the means of subsistence," most assuredly never entered the heads of our forefathers. But, alongside this corporate several ownership, there is strong ground for the belief that individual ownership was recognized, to a certain extent, even in these early times. The inclosure around each dwelling was understood to belong to the family inhabiting the dwelling; and, for all practical purposes, must have been as much owned by the head of it as a modern entailed estate is owned by the possessor for the time being. Moreover, if any member of the community chose to go outside and clear and cultivate some of the waste, the reclaimed land was thenceforth recognized as his—that is to say, the right of ownership, in virtue of labor spent, was admitted.[*]

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* For the difficulties which attach to the establishment of such probable conclusions, see the remarkable work of M. Fustel de Coulanges, "Recherches sur quelques problèmes d'Histoire: Les Germains."

† Inalienable, that is, without the consent of the whole owning community.

Thus it is obvious that, though the early land-holders were, to a great extent, collective owners, the imaginary rights of mankind to universal land-ownership, or even of that of the nation at large to the whole territory occupied, were utterly ignored; that, so far from several ownership being the result of force or fraud, it was the system established with universal assent; and that, from the first, in all probability, individual rights of property, under certain conditions, were fully recognized and respected. Rousseau was, therefore, correct in suspecting that his "state of nature" had never existed—it never did, nor anything like it. But it may be said, supposing that all this is true, and supposing that the doctrine that Englishmen have no right to their appropriation of English soil is nonsense; it must, nevertheless, be admitted that, at one time, the great body of the nation, consisting of these numerous land-owning corporations, composed of comparatively poor men, did own the land. And it must also be admitted that now they do not; but that the land is in the hands of a relatively small number of actually or comparatively rich proprietors, who constitute perhaps not one per cent of the population. What is this but the result of robbery and cheating? The descendants of the robbers and cut-throat soldiers who came over with William of Normandy have been true to their military instincts, and have "conveyed" the property of the primitive corporations into their own possession. No doubt, that is history made easy; but here, once more, fact and *a priori* speculations can not be made to fit.

Let us look at the case dispassionately, and by the light of real history. No doubt, the early system of land-tenure by collective several ownership was excellently adapted to the circumstances in which mankind found themselves. If it had not been so, it would not have endured so long, nor would it have been adopted by all sorts of different races—from the ancient Irish to the Hindoos, and from the Russians to the Caffres and Japanese. These circumstances were in the main as follows: that there was plenty of land unoccupied; that population was very scanty and increased slowly; that wants were simple; that people were content to go on living in the same way, generation after generation; that there was no commerce worth speaking of; that manufactures were really that which they are etymologically—things made by the hands; and that there was no need of capital in the shape of money. Moreover, with such methods of warfare as then existed, the system was good for defense, and not bad for offense.

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[*] Rousseau himself not only admits but insists on the validity of this claim in the "Contrat Social," liv. i, chap. ix.

Yet, even if left to itself, to develop undisturbedly, without the intrusion of force, fraud, or militarism in any shape, the communal system, like the individual-owner system or the state-owner system, or any other system that the wit of man has yet devised, would sooner or later have had to face the everlasting agrarian difficulty. And the more the communities enjoyed general health, peace, and plenty, the sooner would the pressure of population upon the means of support make itself felt. The difficulty paraded by the opponents of individual ownership, that, by the extension of the private appropriation of the means of subsistence, the time would arrive when men would come into the world for whom there was no place, must needs make its appearance under any system, unless mankind are prevented from multiplying indefinitely. For, even if the habitable land is the property of the whole human race, the multiplication of that race must, as we have seen, sooner or later, bring its numbers up to the maximum which the produce can support; and then the interesting problem in casuistry, which even absolute political ethics may find puzzling, will arise: Are we, who can just exist, bound to admit the new-comers who will simply starve themselves and us? If the rule that any one may exercise his freedom only so far as he does not interfere with the freedom of others is all-sufficient, it is clear that the new-comers will have no rights to exist at all, inasmuch as they will interfere most seriously with the freedom of their predecessors. The population question is the real riddle of the sphinx, to which no political Œdipus has as yet found the answer. In view of the ravages of the terrible monster over-multiplication, all other riddles sink into insignificance.

But to return to the question of the manner in which individual several ownership has, in our own and some other countries, superseded communal several ownership. There is an exceedingly instructive chapter in M. de Laveleye's well-known work on "Primitive Property," entitled "The Origin of Inequality in Landed Property." And I select M. de Laveleye as a witness the more willingly, because he draws very different conclusions from the facts he so carefully adduces to those which they appear to me to support.

After enumerating various countries in which, as M. de Laveleye thinks, inequality and an aristocracy were the result of conquest, he asks very pertinently:

> But how were they developed in such countries as Germany, which know nothing of conquerors coming to create a privileged caste above a vanquished and enslaved population? Originally we see in Germany associations of free and independent peasants like the inhabitants of Uri, Schwyz, and Unterwalden at the present day. At the close of the middle ages we find, in the same country, a feudal aristocracy resting more heavily on the soil, and a rustic population more completely enslaved than in England, Italy, or France (p. 222).

The author proceeds to answer the question which he propounds by showing, in the first place, that the admission of the right of individuals and their heirs to the land they had reclaimed, which was so general, if not universal, created hereditary individual property alongside the communal property, so that private estates arose in the waste between the sparse communal estates. Now, it was not every family or member of a community that was enterprising enough to go out and clear waste lands, or that had the courage to defend its possessions when once obtained. The originally small size of the domains thus acquired, and the strong stimulus of personal interest, led to the introduction of better methods of cultivation than those traditional in the communes. And, finally, as the private owner got little or no benefit from the community, he was exempted from the charges and *corvées* laid upon its members. The result, as may be imagined, was that the private proprietors, aided by serf-labor, prospered more than the communities cultivated by their free members, seriously hampered them by occupying fresh waste lands, yielded more produce, and furnished wealth, which, with the help of the *majorat* system, remained concentrated in the hands of owners who, in virtue of their possessions, could maintain retainers; while, freed from the need to labor, they could occupy themselves with war and the chase, and, as nobles, attend the sovereign. On the other hand, their brethren, left behind in the communes, had little chance of growing individually rich or powerful, and had to give themselves up to agricultural toil. The Bishop of Oxford, in his well-known "Constitutional History of England" (vol. i, p. 51), puts the case, as his wont is, concisely and precisely: "As the population increased, and agriculture itself improved, the mark system must have been superseded everywhere." No doubt, when the nobles had once established themselves, they often added force and fraud to their other means of enlarging their borders. But, to begin with, the inequality was the result, not of militarism, but of industrialism. Clearing a piece of land for the purpose of cultivating it and reaping the crops for one's own advantage is surely an industrial operation, if ever there was one.

Secondly, M. de Laveleye points out that the Church was a great devourer of commune lands:

"We know that a member of the commune could only dispose of his share with the consent of his associates, who had a right of resumption; but this right could not be exercised against the Church. Accordingly, in these days of religious fervor, the faithful frequently left to the Church all that they possessed, not only their house and its inclosure, but the undivided share in the *mark* attached to it" (p. 225). Thus an abbot, or a bishop, became co-proprietor with the peasants of a commune; and, with such a cuckoo in the nest, one can conceive that the hedge-sparrows might have a bad time. "Already by the end of the ninth century one third of the whole soil of Gaul belonged to the clergy" (p. 225). But, if the men who left their property to the Church believed that they got their *quid pro quo* in the shape of masses for their souls, as they certainly did; and if the churchmen believed as sincerely (and they certainly did) that they gave valuable consideration for the property left them, where does fraud come in? Is it not again a truly industrial operation? Indeed, a keen-witted and eminent Scotch judge once called a huge bequest to a church "fire insurance," so emphatically commercial did the transaction appear to him.

Thirdly, personal several property was carved out of the corporate communal property in another fashion, to which no objection can be taken by industrialism. Plots of arable land were granted to members of the commune who were skilled artificers, as a salary for their services. The craft transmitting itself from father to son, the land went with it and grew into an hereditary benefice.

Fourthly, Sir Henry Maine* has proved in a very striking manner, from the collection of the Brehon laws of ancient Ireland, how the original communal land-ownership of the sept, with the allotment of an extra allowance of pasture to the chief, as the honorarium for his services of all kinds, became modified, in consequence of the power of keeping more cattle than the rest of the sept, thus conferred on the chief. He became a lender of cattle at a high rate of interest to his more needy sept fellows, who when they borrowed became bound to do him service in other ways and lost status by falling into the position of his debtors. Hence the chief gradually acquired the characteristics of what naturalists have called "synthetic" and "prophetic" types, combining the features of the modern gombeen-man with those of the modern rack-renting landlord, who is commonly supposed to be a purely imported Norman or Saxon product, saturated with the very spirit of industrialism — namely, the determination to get the highest price for an article which is to be had. As a fact, the condition of the native Irish, under their own chiefs, was as bad in Queen Elizabeth's time as it has ever been since. Again, the status of the original commoners of the sept was steadily altered for the worse by the privilege which the chief possessed, and of which he freely availed himself, of settling on the waste land of the commune such broken vagabonds of other tribes as sought his patronage and protection, and who became absolutely dependent upon him. Thus, without war and without any necessity for force or fraud (though doubtless there was an adventitious abundance of both), the communal system was bound to go to pieces, and to be replaced by individual ownership, in consequence of the operation of purely industrial causes. That is to say, in consequence of the many commercial advantages of individual ownership over communal ownership; which became more and more marked exactly in proportion as territory became more fully occupied, security of possession increased, and the chances of the success of individual enterprise and skill as against routine, in an industrial occupation, became greater and greater.

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* See "Early History of Institutions," epecially Lecture vi.

The notion that all individual ownership of land is the result of force and fraud appears to me to be on a level with the peculiarly short-sighted prejudice that all religions are the results of sacerdotal cunning and imposture. As religions are the inevitable products of the human mind, which generates the priest and the prophet as much as it generates the faithful; so the inequality of individual ownership has grown out of the relative equality of communal ownership in virtue of those natural inequalities of men which, if unimpeded by circumstances, can not fail to give rise quietly and peaceably to corresponding political inequalities.

The task I have set myself is completed, as far as it can be within reasonable limits. I trust that those who have taken the trouble to follow the argument will agree with me that the gospel of Jean-Jacques, in its relation to property, is a very sorry affair—that it is the product of an untrustworthy method, applied to assumptions which are devoid of foundation in fact; and that nothing can be more profoundly true than the saying of the great and truly philosophical English jurist, whose recent death we all deplore, that speculations of this sort are rooted in "impatience of experience, and the preference of *a priori* to all other methods of reasoning."

Almost all the multitudinous causes which concurred in bringing about the French Revolution are happily absent in this country; and I have not the slightest fear that the preaching of any amount of political fallacy will involve us in evils of the magnitude of those which accompanied that great drama. But, seeing how great and manifold are the inevitable sufferings of men; how profoundly important it is that all should give their best will and devote their best intelligence to the alleviation of those sufferings which can be diminished, by seeking out, and, as far as lies within human power, removing their causes; it is surely lamentable that they should be drawn away by speculative chimeras from the attempt to find that narrow path which for nations, as for individual men, is the sole road to permanent well-being.—*Nineteenth Century.*

SLOYD: ITS AIM, METHOD, AND RESULTS.

By FRIMANN B. ARNGRIMSSON.

SLÖJD, anglicized into *sloyd*, is a Swedish word, meaning dexterity or manual skill (compare old Norse *sldegd*, cunning, and English *sly*). Of late, however, the word has been restricted to denote a system of manual training.

This system came originally from Finland, but was adopted some fifteen years ago in Sweden, and there perfected in its methods. The Finnish teacher Zygnaus is its originator; but to Messrs. A. Abrahamson and O. Salomon,[*] of Nääs, Sweden, is due the honor of having adapted it to the use of schools and made it generally known. For fifteen years their institute has been growing in importance, and in that time over one thousand teachers have been trained there and sent out to different parts of the world. Hence this method has often been called the Nääs system of manual training.

The *aim* of the system is not to teach the pupil a trade, but to educate him. Its primary object is to insure a healthy physical and mental development, while its secondary object is to secure general dexterity useful in every vocation.

The *method* is based upon the principle that a harmonious mental development is best secured through a harmonious physical development, promoted by exercise. It proceeds first to call the physical activities into play, and by stimulating, strengthening, and training these, it seeks to awaken, develop, and cultivate the powers of the mind. Taking advantage of the pupil's natural activity, it permits him to engage in work so arranged as to lead him to discover the principles to be taught, to apply his knowledge, and thus obtain a useful training.

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[*] For more detailed accounts of the Sloyd system, consult the writings of Dr. O. Salomon, Miss C. Lord, Prof. W. T. Harris, P. M. Sluys, etc.

The instruction is on the inductive plan, mainly through practical exercises, but in part oral. Class instruction is used only when general directions must be given, as when commencing a class, explaining the use of tools, position, etc. Otherwise, individual instruction is employed, it being found to yield the best results; but, as the pupil advances, the teacher's aid becomes less necessary.

The training consists mainly in performing certain exercises calculated to give general dexterity, promote health and strength, and at the same time develop the perceptive faculties, ingenuity of construction, concentrated attention, love of exactness, and artistic taste.

The exercises, though necessarily varying with the requirements of different localities, must embody the leading principles of the system; be conducive to health and development; pleasing, so as to interest the pupil; varied, so as to exercise the various faculties; and graded, so that the pupil may, with the mere guidance of the teacher, pass from the first and simplest to the last and most difficult.

Series of objects or models made of wood (Figs. 1 and 2) are used to illustrate the exercises. These models, though varying according to localities, must always represent useful articles; be of pleasing forms, in which curved lines largely enter; be varied, so as to demand variety of skill; and be systematically arranged, so that each subsequent model requires an exact copy of the preceding. All careless work must be excluded, as also polishing and painting, in order to secure the more thorough workmanship. The tools comprise all the essential ones used in carpentry—as the knife, the hammer, the center-bit, the try-square, compasses, saws, files, planes, etc. The work-room must be spacious, airy, and well lighted, and the work-benches should turn, so that when the pupil is at work the light shall fall on him chiefly from the left side. The teaching should not be intrusted to others than those who have natural qualifications for the work, have been instructed in the science of education, and trained in the system of Sloyd.

The courses of instruction must necessarily depend on circumstances, but the instruction falls naturally into three stages, viz., an elementary, an intermediate, and an advanced course; or, more simply, into an elementary course for children, and an advanced course for older pupils. In any case the period of instruction may be made to coincide with that of the common school.

What relation Sloyd bears to other systems of manual training can here be merely indicated in a very general way. This system agrees with other systems of manual training in making physical exercise the basis of its instruction and training, also in adopting the inductive method of teaching. But it differs from most of these in using wood as the only material for construction, and in the form of its models. From the various handicrafts in wood, as carpentry, wood-carving, wood-engraving, etc., it differs in not being a trade; and from other Sloyd systems, in avoiding their tendency of either aiming at a mere technical skill or a mere mental discipline. Thus, it differs from those adopted in France and Denmark in being less technical, from those in Germany in being less theoretical, and from the Russian system chiefly in laying greater stress on the utility of the articles and introducing curved lines at an earlier stage.

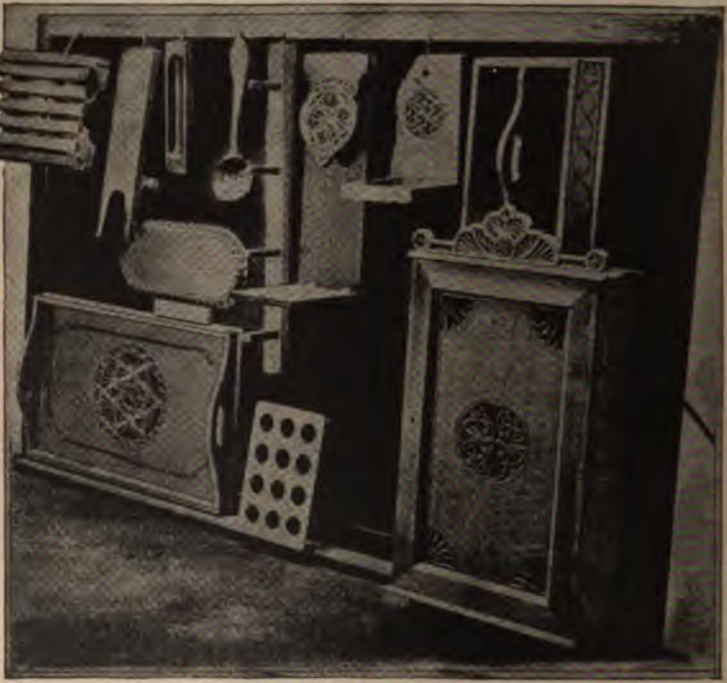


FIG. 1.—MODELS.

How far Sloyd may be adopted in the public schools has been extensively discussed in Europe. That it should be introduced into the public schools, either as a separate branch of study or incorporated with the ordinary branches as a continuation of the Kindergarten system, has been earnestly urged by some schools of pedagogy, and as strenuously opposed by others. It is not possible to enter fully into the subject here; but it may be noted that the principal teacher of Sloyd, Director Salomon, unhesitatingly claims that its introduction into the public schools would be beneficial, directly promoting general health, and indirectly by facilitating the acquisition of other studies.

It has been claimed by many advocates of this system that it is better than most others, supplies a healthful training, without becoming on the one hand a mere trade, or on the other a mere theoretic study; that while it trains in general dexterity and promotes physical development, it at the same time strengthens and disciplines the faculties of the mind; cultivating the perceptives, especially the senses of form and order; training the power of comparison, constructiveness, and concentration of thought; besides awakening a liking for manual labor, respect for manual workers, love for the true, and taste for the beautiful. Whatever may be said to the contrary, so much is certain that, if properly taught, Sloyd is a valuable means to education and an important complement to the ordinary branches of school studies. This is borne out by its phenomenal success in Sweden, its extensive adoption in countries where education is most advanced, as in Germany, France, and Great Britain, and by its growing popularity on this side of the Atlantic.

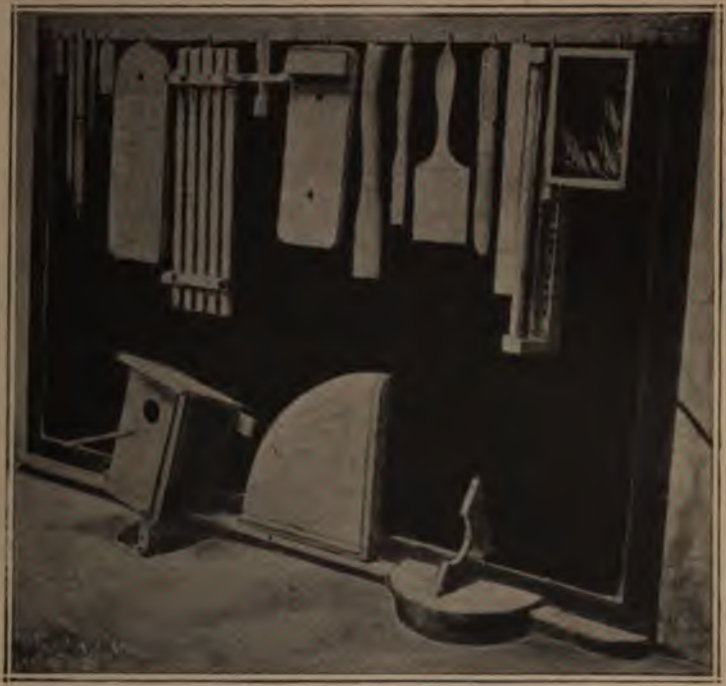


FIG. 2.—MODELS.

Some idea of how Sloyd is succeeding on this continent may be gleaned from the following extract from the "Midsummer Report of the Sloyd School" at No. 10 Warrenton Street, Boston:

"This school was started by Mrs. Quincy A. Shaw. It is superintended by Mrs. F. S. Fiske. The Sloyd instruction is given by Mr. G. Larsson, formerly a teacher in the normal school at Nääs, Sweden.

"The school began in November, 1888, in the Warrenton Street Chapel, the intention being to show the principles of the Swedish method of manual training—modified, however, according to American requirements. The course from November 1, 1888, to July 1, 1889, has been carried on with continually growing interest on the part of the pupils. As the course has been free, with no obligatory attendance whatever, it is astonishing to see with what interest and attention it has been followed, not only by the grown-up pupils, but especially by the younger ones.

"The number of pupils who have received instruction is above one hundred and forty; of these, fifty-three were lady teachers, twenty working-girls, thirty-seven boys between the ages of ten and sixteen years, ten young men, and twenty from the Horace Mann School (deaf and dumb).

"About fifty of the pupils have begun the normal course, but the time has been too short for any of these to finish the series.

"The pupils have to complete a copy of each model as exactly as possible before they begin the next number.

"As soon as they have completed the series, they will have a few lessons in sharpening tools; also get practice in teaching pupils; and by short discussion obtain some knowledge of the different systems of manual training in wood, their advantages, disadvantages, etc."

Since this report was written the school has steadily increased, so that now the pupils number over two hundred. Of these about eighty are boys, the rest being chiefly teachers from the city schools. There are two courses provided, and a third more advanced course will be added if necessary. The time required for completing a course varies from one hundred and fifty to two hundred hours, according to the pupil's ability. The pupils are divided into classes of twenty each, and these meet at stated times, generally twice a week, the lessons being usually of two hours' duration. Admission to the school is limited to teachers, boys from the public schools, and deaf-mutes from the Horace Mann School. Tuition is free.

The following table of the first six models, in a series of twenty-five, shows that the order of the exercises is the essential quality of a series of models:

No.	Model.	New exercises.	New tools.	Kind of wood.	Dimensions—ins.	Drawing.
1	Wedge.	Whittling.	Knife, rule, lead-pencil.	Pine.	$3 \times 1 \times \frac{1}{4}$	Parallel lines.
2	Flower-pin.	Square whittling.	Knife, rule, and lead-pencil.	Pine.	$12 \times \frac{1}{2}$	Parallel lines.
3	Flower-stick.	Square sawing and planing.	Splitting-saw, jack-plane, try-square, and marking-gauge.	Pine.	$15 \times \frac{1}{2}$	How to find the
4	Pen-holder.	Curved whittling and boring.	Center-bit.	Hard pine.	$8 \times \frac{1}{2}$	Free-hand drawing of curved lines.
5	Cutting-board.	Round sawing, filing, and using of block-plane.	Cross-cut saw, turning saw, compasses, flat file, block-plane, center-bit and back-saw.	Pine or white-wood.	$17 \times 6 \times \frac{5}{8}$	How to find the center of a line; to draw a circle, given the radius or two tangents.
6	Flower-pot stand.	Nailing and using of bench-hook.	Hammer and bench-hook.	Pine.	$20 \times 6 \times \frac{5}{8}$	Continued elem'ntary drawing.

A GLIMPSE OF THE SLOYD SCHOOL IN BOSTON.—It is a rather remarkable building, that chapel at No. 10 Warrenton Street. The first floor is used for Kindergarten and evening school, the second for a church and lecture-room, while on the third floor is a Sloyd school.

Here the visitor enters a large, well-lighted hall (Fig. 3), with two rows of benches along the sides, and at each bench is a student. It may be that a class of teachers is at work, teachers mature in years and experience, of delicate frames, care-worn countenances, watchful eyes, aquiline noses, now and then adorned with a pair of gold spectacles—gentlemen, men of polite address, ladies of queenly deportment—all at present whittling or hammering, sawing or planing, like genuine carpenters, exercising many a delicate muscle now perhaps for the first time in their lives, working with a will, even enthusiasm, which can not be explained on the supposition that they are trying to atone for the sins of their quondam educators. No, they are here to educate themselves, that they may the better educate those placed in their charge; and it is this which makes their work sublime, even sacred. Or it may happen that a class of youths are at work—boys from the public schools or the machine-shops, factory-girls and servant-girls; youths who feel the irksome and unhealthy influence of hard service, who are debarred by utter poverty, arrogant pride, or blind custom, from obtaining that education which their gentle, aspiring, and noble natures desire—debarred from the full development and the free exercise of their God-given faculties; youths of untutored talents as well as those of well-instructed minds are here. And all engage in the work; all take hold with a will, even with joy. For they feel the blood course more freely in their veins, hear the wind breathe sweeter music, and see the light weave a more lovely world of colors. Their dormant energies are awakened, the heightened color on the cheek, the lustrous laughing eye, the merry mobile lip, the fair white hand, the whole person speaks in eloquent language the pleasure which springs from progress, or a work well done.

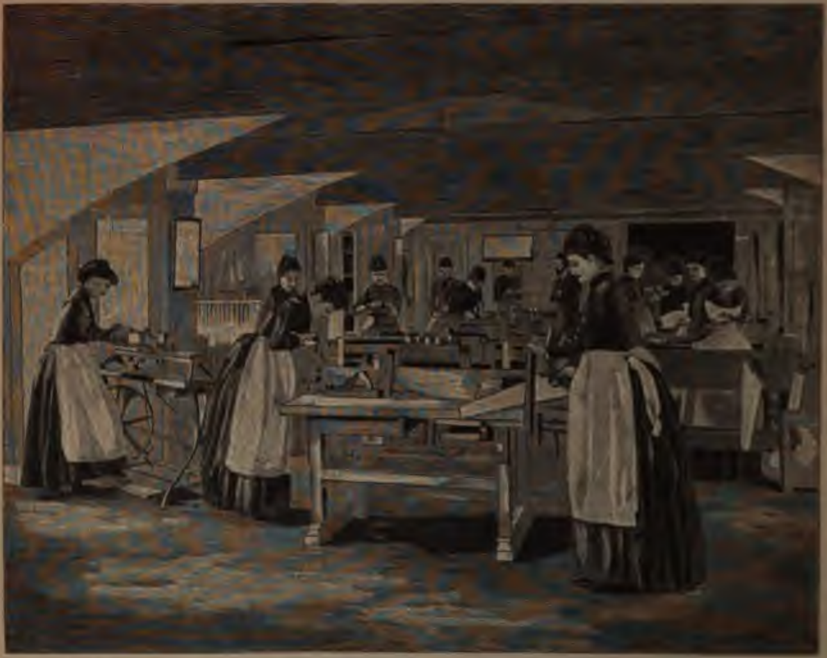


FIG. 3.—FREE SLOYD SCHOOL—NORMAL CLASS.

But it may be that neither mature teachers nor tender youths are at their benches, but playful, frolicsome children flitting about their work like butterflies about a flower, and working with glee, learning almost unconsciously. Here is a batch of boys, there a group of girls, who at other times might be called a little unruly; they are now all attention, their minds concentrated on the curious models before them; and, while the exercise lasts, there is no indication of unrestrained spirits.

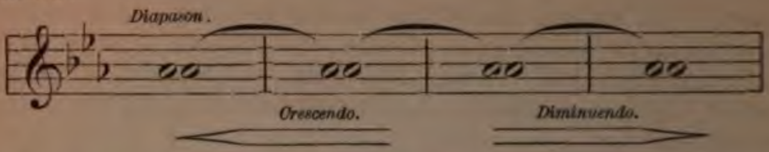
But perhaps the school presents none of these sights, but a very different one; a sight half sad, yet not without a ray of gladness; a picture not composed of trained teachers, or boisterous youths, or prattling children, eagerly listening, and as eagerly speaking, but of a group of deaf and dumb. And now, if ever, you may see what intense enthusiasm may be thrown into manual training. The poor unfortunates deprived of hearing and of speech find here a new field in which to exercise their minds and express their ideas. By their very disabilities they are enabled to concentrate their minds better than their more fortunate brethren, and even outstrip them in excellence of workmanship. Among the boys there is a deaf-mute some sixteen years of age who surpasses all others in the school, a result attained not by superior talent but by close application. Near him another boy of magnificent build and great ability dashes off his work—now planing, now carving, with a master hand. On the other side of the room, in the midst of that row of girls—neat, even pretty girls—there are two most noticeable; one a brunette, whose quick, observant eye omits nothing while her snow-white hand deftly draws and carefully carves the model. Beside her stands a quiet blonde with blue, thoughtful eyes, carefully examining her model; and then, as if suddenly discovering some new principle, makes a gesture of joy and resumes her work. At the close of the exercise she takes the finished model to her teacher, and, with a pleasant smile, joyful feelings struggling for expression in her soulful face, says, in the deaf-mute language, "I love this work."

THE MYSTERIOUS MUSIC OF PASCAGOULA.

By CHARLES E. CHIDSEY.

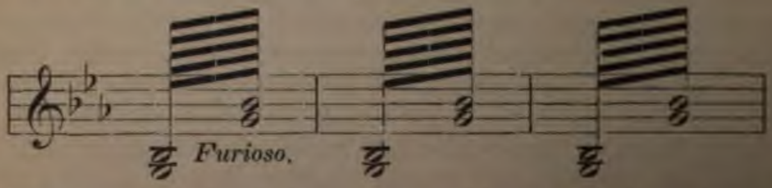
ANY one examining a map of the Mississippi coast will find indicated thereon, about one hundred miles east of New Orleans, the town of Scranton, or East Pascagoula, situated at the mouth of the Pascagoula River. The waters of this river have become famous in "song and story" for the strange sounds which they give forth as they slowly make their way to the Gulf. For forty years or more a great deal has been written in prose and verse about this mysterious music of Pascagoula, yet no one that I know of has ever attempted to give an accurate description or a plausible explanation of the phenomenon. In the following paper it is my purpose to describe the sounds as I have often heard them, and for an explanation of the mystery to give a theory, long since advanced by Darwin and Rev. Charles Kingsley, to explain the cause of similar music heard on the southern coast of France.

It was late one evening in September, 1875, that I first heard the mysterious music of Pascagoula. An old fisherman called me from the house where I then was, to come down on the river-bank and "hear the spirits singing under the water." Full of eager curiosity, I readily obeyed the summons, and, if what I heard can not be properly called music, it was certainly mysterious. From out of the waters of the river, apparently some forty feet from its shelving bank, rose a roaring, murmuring sound, which gradually increased in strength and volume, until it had reached its height, when it as slowly descended. It may be represented as follows:



It never advanced or receded, but seemed always in the same spot; and, though I remained there some time, it never ceased, but continued to rise and fall in the manner that I have indicated above. The reader may obtain a better idea of the music if he will place his ear against a telegraph-pole, the timber of which, acting as a sounding-board for the wires that are played upon by the wind, gives forth a strange, tremulous sound, that is an exact counterpart of the "music of Pascagoula"—with this difference, however, that whereas the music of the wires is very wavering and tremulous, that of the water rises and falls with a steady swell.

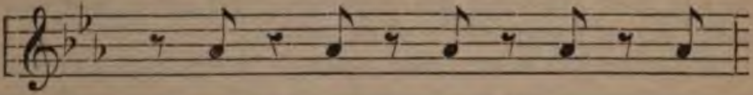
One evening in October, some years after the event above mentioned, while seated on an old wharf on the banks of the Pascagoula River, idly watching the ever varying and shifting hues of the setting sun, pointing with my finger across the wide extent of marsh that stretched before me to a squall that was raging in the Gulf, I remarked to my companion how distinctly we could hear the roar of the wind, though the storm was so far off. "That," she replied, "is not the storm that you hear, but the mysterious music." Approaching the edge of the wharf upon which we sat, and leaning over, I soon ascertained the truth of her words, for from out of the water came a roaring, rushing sound like that of a mighty wind, that may be represented thus:



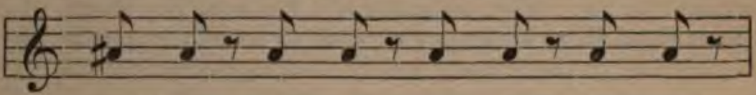
The sound, however, was not caused by the wind passing between the wharf and the water, as there was very little breeze where we were, and, though I visited the spot some time afterward, it abated but little. I have been frequently told by fishermen that, when fishing at night on the waters of the Pascagoula, should they hear the mysterious music and make an unusual sound by splashing the water with an oar, or jumping overboard, the music will instantly cease, to begin again as soon as all is quiet.

A few days ago I was told, by a lady residing here, that one night this summer, while rowing upon the river, she heard the music. "As we approached the sound," she said, "it seemed to go away from us, but we continued to follow it even some distance up the bayou on the other side of the river, when, for fear of losing ourselves in the intricate windings of the bayou, we left it."

My friend, the late Rev. R. G. Hinsdale, of Biloxi, has told me that at that place there are three different kinds of this music heard, viz.: the first is like that I have described; the second is a quick, sharp note sounded at different intervals, like this:



the third is another note repeated twice, as follows:



As I have before hinted, I have no theory of my own to offer in explanation of the strange phenomenon known as the mysterious music of Pascagoula, but shall merely give the theory that was advanced by Darwin years ago. In his "Descent of Man," page 347 (revised edition), Darwin says, "The last point which need be noticed is that fishes are known to make various noises, some of which are described as being musical. Dr. Dufossé, who has especially attended to this subject, says that the sounds are voluntarily produced in several ways by different fishes: by the friction of the pharyngeal bones; by the vibration of certain muscles attached to the swim-bladder, which serves as a resounding-board; and by the vibration of the intrinsic muscles of the swim-bladder. By this latter means the Trigla produces pure and long-drawn sounds which range over nearly an octave. But the most interesting case for us is that of two species of Ophidium, in which the males alone are provided with a sound-producing apparatus, consisting of small movable bones, with proper muscles, in connection with the swim-bladder. The drumming of the Umbrinas in the European seas is said to be audible from a depth of twenty fathoms, and the fishermen of Rochelle assert that 'the males alone make the noise during the spawning-time, and that it is possible, by imitating it, to take them without bait.'"

Whether or not these fishes inhabit or visit the waters of the

Pascagoula, I am unable to say; but if Darwin's views are correct, and I have no doubt that they are, then we have a very probable explanation of the mysterious music; if not, then we are as much in the dark as ever.*

THE INDWELLING SPIRITS OF MEN.

By Hon. Major A. B. ELLIS.

IN the spring of 1889 an officer of the United States Army, who was visiting Nassau, N. P., for the benefit of his health, lent me a pamphlet, a reprint of Dr. Washington Matthews's "The Prayer of a Navajo Shaman," which had originally been published in the "American Anthropologist" for April, 1888, and at page 19 of that pamphlet I read as follows:

"The suppliant is supposed, through the influence of witchcraft, exercised either in this world, or in the lower world when in spirit he was traveling there, to have lost his body, or parts thereof—not his visible body, nor yet his soul, his breath of life—for both of these he knows himself to be still in possession of, but a sort of spiritual body which he thinks constitutes a part of him—the astral body, perhaps, of our theosophic friends. This third element of man belongs not only to his living person, but to things which pertain to it, such as his ejected saliva, his fallen hair, the dust of his feet, etc."

What struck me in this passage was the curious analogy between the belief thus stated to be held by the Navajos and one which, in the course of my investigation of the religious systems of the negroes of West Africa, I had discovered to be held by the various tribes of the Gold and Slave Coasts; and it is with the object of calling the attention of American anthropologists to this third element in man that I venture to put forward this paper.

The Navajo believes that there are three entities in man: (1) The corporeal man; (2) his soul, the vehicle of independent personal existence, which, at the death of the body, survives and continues its career in the land of spirits; (3) his spiritual body, which Dr. Matthews terms his "third element." The Tshi-speaking negroes of the Gold Coast—that is, the Ashantis, Fantis, Wassaws, Gamans, and several other tribes—believe similarly in three entities: (1) The corporeal man; (2) his soul, or ghost; (3) the indwelling spirit of the living man, which they term his *kra*.

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* [Prof. G. Brown Goode, in his "American Fishes," mentions several species to which the name Drum has been given because of their ability to produce sounds. In his account of the Sea Drum he says: "Another historical incident is connected with *Pogonias*. The legend of Pascagoula and its mysterious music, deemed supernatural by the Indians, is still current. 'It may often be heard there on summer evenings,' says a recent writer. 'The listener being on the beach, or, yet more favorably, in a boat floating on the river, a low, plaintive sound is heard rising and falling like that of an Æolian harp, and seeming to issue from the water. The sounds, which are sweet and plaintive, but monotonous, cease as soon as there is any noise or disturbance of the water.' Bienville, the French explorer, heard the music of Pascagoula when he made his voyage in 1699 to the mouths of the Mississippi, and his experiences are recorded in his narrative." Speaking of the Lake Drum, Prof. Goode remarks: "These names, 'Croaker,' 'Drum,' 'Thunder-pumper,' etc., refer to the croaking or grunting noise made by this species in common with most Sciænoids. This noise is thought to be made in the air-bladder by forcing the air from one compartment to another."—EDITOR.]

Now, though the *kra* has frequently been confounded with the soul or ghost, it is essentially distinct. The soul or ghost only comes into being when the corporeal man ceases to exist, and so may be considered to be the latter deprived of his material body; but the *kra*, the Tshi-speaking negro believes, existed independently before the birth of the man, and after his death will continue to exist equally independently of the soul or ghost. A *kra* may have, and almost always has, been a *kra* in the bodies of other men since deceased, and, at the death of the individual whose body he is now tenanting, will seek to enter the body of some new-born human being. Failing this, it enters the body of an animal, and, if unable to enter the body either of a human being or of an animal, it becomes a *sisa*, a *kra* without a tenement, and wanders about the earth, causing sickness to mankind. The ghost or soul which, at the death of the corporeal man, proceeds to Dead-land, and there continues the former vocations of the man, and for whose service in Dead-land slaves and wives are sacrificed, and arms, implements, and clothing buried with the corpse, is the vehicle of individual personal existence, the true soul; and the *kra*, whose connection with the man commences with the birth and terminates at his death, is something quite different.

The difference between the *kra* and the soul is also well shown by the different results which ensue when they quit the body. The *kra* can and does quit the body at will. Usually it does so only during the sleep of the man, who is unconscious of its departure, and its adventures are the occurrences of which the man dreams. If it should leave while the man is awake, the latter is only made conscious of it, if at all, by a yawn, a sneeze, a shudder, or some such slight convulsion, which indicates to him that his *kra* is going out. In any case, whether sleeping or waking, he suffers no pain, feels no inconvenience, and is subject to no apparent change consequent on the departure of his *kra*. The absence of the *kra* is, however, dangerous, as it affords an opportunity for a *sisa*, or *kra* without a tenement, to enter the vacant body, for which the *insisa* are believed to be always on the lookout. The man is not conscious of the entry of the *sisa*, and nothing happens until the *kra* returns and attempts to eject the intruder, when the effect of the internal struggle is to throw the man into convulsions. In this manner the West African negroes seek to account for epileptic and similar seizures; they are what used to be termed cases of "possession," but they are not directly attributable to the departure of the *kra, per se.*

When, however, the soul quits the body, the latter falls at once into a motionless and lifeless condition. Sometimes, though but rarely, the soul returns, and then the man has been in a swoon or trance; more frequently it does not return, and then the man is dead. It is in the hope that the soul may return that appeals to the dead to come back are always made, and that the corpse is kept until the signs of corruption show that the soul has gone forever. The difference, then, between the results of departure is clear. When the *kra* departs, there is no direct and immediate result, though the departure may lead to "possession"; but when the soul departs, the direct and immediate result is suspended animation or death.

The Ewi-speaking peoples of the Slave Coast—the Awunas, Krepis, Dahomis, Mahis, etc.—hold exactly similar views; the third element, or indwelling spirit of man, being by them termed a *luivo.* The Ga-speaking peoples of the eastern districts of the Gold Coast have modified the more original conception, and believe that each individual has two *kla* (the Ga-term for *kra*), a male and a female, the former being of a bad disposition and the latter of a good.

By all the tribes of these three lingual groups the indwelling spirit is believed to afford some protection to man. It receives occasional thank-offerings, and the anniversary of each individual's day of birth is held as a day sacred to the spiritual tenant. On this account the *kra* may be regarded in some respects as a guardian spirit, dwelling in the body of the man; but it is more than that. Its close connection with the man himself is indicated by the fact of its nocturnal adventures during its absence from the body being remembered by the man when he awakes. The latter even feels physically the effects of his *kra's* actions; and when the negro awakes from sleep feeling stiff and unrefreshed, or with limbs aching from muscular rheumatism, he invariably attributes these symptoms to the fact of his *kra* having been engaged in some struggle or some severe toil. If, moreover, a man dreams of other men, he believes that his *kra* has met theirs; consequently, the *kra* is held to have the outward appearance of the man whose body he tenants. Hence the *kra* is more than a mere tenanting or guardian spirit. He has, though doubtless only in a shadowy form, the very shape and appearance of the man; and both the mind and body of the latter are affected by and register the results of the *kra's* actions. How the notion of such an existence came into being it is beyond the province of this paper to inquire. It is sufficient that it does exist, and that the *kra* is believed to be essentially distinct from the soul or ghost, which, at the death of the body, proceeds to Dead-land, and there continues the life that the man led in the world.

I am unaware if American anthropologists have considered this third element of man, and its bearing upon the theory of animism, or even if instances of the belief being held, other than that mentioned by Dr. Washington Matthews, have been recorded; but in Europe it seems quite to have escaped notice, and the belief is not referred to in any one of the text-books of anthropology that I have examined. This is doubtless in consequence of the German missionaries in West Africa having translated the words *kra*, *kla*, and *luivo* as "soul," a term which is not at all applicable, and which has led to the third element being confused with the soul proper.

It is in its bearing upon that branch of animism which is termed Nature-worship that this third element seems most important. The negroes of the Gold and Slave Coasts, like every other people low in the stage of civilization, believe that inanimate as well as animate objects have souls or ghosts—a belief which is proved by the practice of burying arms, implements, utensils, etc., for the use of the dead in Dead-land. The soul or ghost of the dead hunter goes to Dead-land, and there continues the former pursuit of the man, using the souls or ghosts of the weapons buried with him; but the negroes have gone beyond this, and, just as they believe man to possess a third element or indwelling spirit, so do they believe that every natural object, everything not made by human hands, has, in addition to its soul or ghost, a third element or spiritual individuality. They hold that just as, when the man dies, the *kra* of the man enters a new-born child, and the soul or ghost-man goes to Dead-land; so, when the tree dies, the *kra*, so to speak, of the tree enters a seedling, and the ghost-tree goes to join the ranks of the shadowy forest in Dead-land. And it is these animating or spiritual tenants of natural objects and natural features that the negro fears, and consequently worships.

The process is something like this: Some day a man falls into a river and is drowned. The body is recovered by the man's comrades, and is found to present no sign of external injury which, in their experience, would account for death. Being necessarily ignorant of the processes by which life is maintained, and seeking for a cause to which to attribute the disaster, they conceive the spiritual tenant or spiritual individuality of the river to have killed their comrade. And to this day, when a negro is drowned, his friends say, "So-and-so" (the spirit or god of the river) "has taken him down." Whether it was with the design of accounting satisfactorily for such accidents—for to man in a low state of culture nothing happens by chance—that the negro extended to natural objects and features the theory of a third element which he had hitherto restricted to himself; or whether he had already formed the belief that such objects and features possessed spiritual individualities, and such accidents only proved to him the malignity and power for evil of those beings, the result would be the same. In either case he would seek to propitiate these powerful beings, and that class of worship which we term Nature-worship would originate.

The theory of animism is divided into two parts, namely: that which treats of the souls or ghosts of individual creatures or objects, capable of continued existence after the death or destruction of the material part; and that which treats of spiritual beings, or gods, who are held to affect and control man's life and the events of the material world. In explanation of the first belief we have the well-known theory advanced by Mr. Herbert Spencer, Dr. Tylor, and others, and which is now very generally accepted; but for the origin of the second belief we have no such satisfactory explanation, and have to fall back upon the theory that the *dei loci* —the gods of mountains, rivers, lakes, rocks, and trees—are deified dead men, an explanation that will only apply in a few isolated cases. Here, however, on the Gold and Slave Coasts of West Africa, we find ready to hand a belief which explains the origin of such beings. If a tree should fall in the forest and crush a man, those who witness the accident, or find the body crushed under the fallen tree, have no hesitation in immediately attributing the disaster to the indwelling spirit, or third element, of the tree. This is the belief held, and the explanation invariably given. Naturally, those indwelling spirits which time and experience show to be harmless, are not much regarded; the indwelling spirits of stones, bushes, etc., are considered of but little importance, and, though the belief in their existence remains, they are disregarded, and the worship and offerings are applied to propitiate those which are believed to possess both the power and the desire to injure. Hence we find, generally speaking, that the features worshiped are such as rivers, lakes, the sea, cliffs, mountains, etc.—that is, localities in which accidents are more liable to occur. The indwelling spirits or third elements of such features are not regarded as being inseparably bound up with them. Like the *kra* of the man, each ordinarily resides in its own feature or object, but can and does leave it temporarily. At a later stage, when priestcraft has intervened, the indwelling spirit is held to enter the image, made by the priests to represent it, while sacrifice is being offered, and also the priest himself, who then becomes inspired.

It is clear, from their construction, that the Tshi, Ga, and Ewe languages all belong to one family, and that the tribes now speaking them are descended from one common stock. The question then arises, Is this an isolated belief which will account for the origin of Nature-worship in certain districts of West Africa, and must be limited to them; or is it a wide-spread belief which will account for the origin of that form of worship generally? Further researches can alone determine this satisfactorily, but there are certain indications which tend to show that the belief is wide-spread. It must be remembered that it is unusual for students of anthropology to come into direct contact with people in that condition which we term savagery, and ordinary travelers possessing, like all Europeans, the belief in one soul only, and perhaps never having conceived the possibility of a man supposing himself to possess a third element, would be very unlikely to make any inquiries in this direction. Even if a communicative native stated to him his theory of an indwelling spirit, or third element, the traveler would perhaps doubt if he really understood him; but people low in the stage of civilization are not communicative on such points. Consequently, we can not expect to find many indications, but there are some.

Cross tells us[*] that the Karens, who inhabit parts of Burmah, Tenasserim, and Siam, believe in two elements in addition to the corporeal man, viz., the *thah*, which seems to answer to the soul, and the *là* or *kelah*, which is described as a "life-phantom"; and Williams,[†] that the Fijians say that a man's "shadow" or "dark-spirit" goes to Dead-land, and that his "light-spirit" stays near where he dies. These appear to be beliefs somewhat analogous to that in the *kra*, but these different elements have not yet been defined. The *genius natalis* of the Romans, too, presents many points of resemblance to the *kra*. Like it, it entered the man at birth, and attended him till death. It was regarded as a second spiritual self, and the anniversary of the birthday of the man was held as a day sacred to it, libations being offered to the image by which it was represented among the household gods. At a later period of the Roman dominion this belief was modified, and, as among the Ga-speaking peoples of the Gold Coast, a belief in two indwelling spirits, one good and one bad, was formed. It was the latter which appeared to Brutus in the camp at Sardis. "What art thou?" said Brutus; "art thou god or man?" The apparition answered: "I am thy evil genius, Brutus. Thou wilt see me at Philippi."[‡]

It is, however, in America that we find the greater number of indications. Foremost stands Dr. Washington Matthews's above-mentioned account, in which the belief of the Navajo in the third element of man is directly stated; and in connection with this there is the following passage from the "Ethnography and Philology of the Hidatsa Indians,"* by the same learned author:

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[*] "Journal of the American Oriental Society," vol. iv, p. 310.

[†] "Fiji," vol. i, p. 241.

[‡] "Plutarch's Lives" (Marcus Brutus), p. 684.

"They" (the Hidatsa Indians) "worship everything in nature. Not man alone, but the sun, the moon, the stars, all the lower animals, all trees and plants, rivers and lakes, many bowlders and other separated rocks, even some small hills and buttes which stand alone—in short, everything not made by human hands, which has an independent being, or can be individualized, possesses a spirit, or, more properly, a *shade*.

"To these shades some respect or consideration is due, but not equally to all. For instance, the shade of the cottonwood, the greatest tree of the upper Missouri Valley, is supposed to possess an intelligence which may, if properly approached, assist them in certain undertakings; but the shades of shrubs and grasses are of little importance. . . . Formerly it was considered wrong to cut down one of these great trees, and, when large logs were needed, only such as were found fallen were used; and to-day some of the more credulous old men declare that many of the misfortunes of the people are the result of their modern disregard for the rights of the living cottonwood."

These views are exactly similar to those held by the negroes of the Gold and Slave Coasts. With them, as with the Hidatsa Indians, the shades, or third elements, of shrubs and grasses, which experience has proved to be innocuous, are of little importance; while, like the cottonwood, the *Bombax*, the giant of the West African forest, whose gray trunk frequently rises to a height of ninety feet before a single branch is thrown out, is reverenced. The Tshi-speaking peoples have indeed classed the indwelling spirits, or third elements, of these trees into a species called *Srahmantin*—monstrous beings, gray in color and with long hair, who hurl down the decayed trees upon passers-by. How did the Hidatsa Indians form the belief that "everything not made by human hands, which has an independent being, or can be individualized, possesses a spirit, or, more properly, a shade"? Do they, like the Navajos, believe that they possess a third element; and have they, like the negroes of the Gold and Slave Coasts, extended the belief to all nature, or has with them Nature-worship originated in some other way?

Among other instances reported from North America the following may be mentioned: The Algonquins are said to believe in two "souls," one of which goes out during sleep, and whose adventures during its absence are the occurrences dreamed of, while the other stays with the body. The same people are also said to believe that sickness is caused by the man's "shadow" being detached from the body.* The Salish Indians of Oregon regard the spirit as distinct from the vital principle, and capable of quitting the body for a short time without the patient being conscious of its absence†; while the Dakotas are said to believe in four "souls." The first belief seems to resemble the *kra* theory; but here, as in most other cases, the use of the word "soul" tends to confuse the subject.

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* Washington, Government Printing-Office, 1877, p. 48.

When attention is called to the subject, many more instances will no doubt be forthcoming; but here, at all events, is something to work upon: and, having regard to the great strides which the science of anthropology is making in the United States, it will not be difficult for American anthropologists to determine whether a belief in the possession of a third element by man is common to many tribes of the northern continent, and, if so, whether the origin of Nature-worship among such tribes may be attributed to an extension of this belief to natural objects and features.

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NORTHERN LIGHTS.

By WILHELM STOSZ.

THE inhabitants of northern Europe, who passed their days in the midst of vast forests, and whose fancy fashioned the forms of heroes and of gods from the mists that hung over their vales, naturally associated with the gods they worshiped the phenomena of northern lights, which to them were revealed in all their splendor. Thus, the Edda gives descriptions of flaming steeds speeding to Walhalla, and of valkyries dashing on through seething flames. Nations that as yet rest close to Nature's breast do not seek explanations of such phenomena; while those that have risen to a higher plane of culture are in possession of simple descriptions of these occurrences, and also of crude attempts at investigating Nature's wonders. Thus, in the old writings of the Chinese, whose realm was a flourishing one two thousand years before our time, there may be found many accounts of the occurrence of northern lights. They observed red vapors arise in the northern heavens, which spread evenly to both sides; sometimes the fiery sheen was encircled by a large white bow, and flaming rays pierced the vapors. Such descriptions can only refer to northern lights.

In the Greek and Latin classics we find more detailed descriptions of similar phenomena. Aristotle, Cicero, Seneca, Pliny, Lucan, Plutarch, Tacitus, and others describe the appearance of auroras more or less completely. Some authors, instead of giving a simple narration of events, seek for an explanation of what they observed. Of course, these attempts in the main are very *naïve* and without any scientific value.

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* Tanner's "Narrative," p. 291.

† "Primitive Culture," vol. I, p. 437.

Aristotle speaks of red beams in the heavens, of torches and of billows of fire. Seneca compares the phenomena to flashes of lightning, and writes about the blazing of the heavens. According to him, "the gleaming flashes may be caused by violent winds, or by the heat of the upper regions of the air; for, when the fiery phenomenon spreads far, it sometimes extends to the lower region, if it be inflammable."

Pliny writes: "Fiery beams occur likewise; such a one was seen when the Lacedæmonians, vanquished at sea, lost their sway over Greece. Sometimes the heavens cleave; this is spoken of as a 'chasma.' But naught is more terrible for mortals than when a blood-red conflagration starts in the heavens, and from there falls to the earth. This happened in the third year of the one hundred and seventh Olympiad, when King Philip warred in Greece. I, however, believe that these phenomena, as all others, occur at times regulated by Nature, and are not, as most people suppose, to be ascribed to a variety of causes which their fancies invent. They have, however, been premonitors of great misfortune. As they occur so very rarely, the law which they obey remains hidden, and may not be traced." Furthermore, "During the reign of the consuls Caius Cæcilius and Cneius Papirius, and also at other times, light was seen in the heavens, so that night became as day." The words of Lucan, "Fire storming from the north," remind us of the sagas of northern tribes.

The middle ages could not readily free themselves from the influence of the mysterious. Wondrous phenomena, the true nature of which was not grasped and understood, were veiled in mystery, and ascribed to the workings of demons. This is proved by many records and traditions. Does not Shakespeare possibly refer to northern lights in "King Henry VI," Part III, act ii, scene 1?—

> Rich. See, how the morning opes her golden gates,
> And takes her farewell of the glorious sun!
> How well resembles it the prime of youth,
> Trimm'd like a younker, prancing to his love!
> Edw. Dazzle mine eyes, or do I see three suns?
> Rich. Three glorious suns, each one a perfect sun;
> Not separated with the racking clouds,
> But sever'd in a pale clear-shining sky.
> See, see! they join, embrace, and seem to kiss,
> As if they vow'd some league inviolable:
> Now are they but one lamp, one light, one sun.
> In this the heaven figures some event.

Many investigators consider the observations of Gassendi, which relate chiefly to the phenomena of 1621, as the starting-point toward a more correct conception of the nature of northern lights. The first move toward a truly scientific investigation into the matter was made by Halley, who in 1716 suggested that auroras were a magnetic exudation from the northern pole of the globe. His contemporaries did not share Halley's opinion. Wolf, in Halle, maintained that the lights consisted of inflammable sulphurous fumes. Descartes and Triewåld saw in them only a reflection of the snow and ice at the north pole. Mairan (1733) considered them formed by a blending of zodiacal light with the earth's atmosphere. The famous mathematician Euler adhered to a sort of nebular hypothesis and declared the aurora to be a phenomenon similar to that presented by the tails of comets. Halley had arrived at his view through the observation that the center line of the light-arc deviated to the west of the meridian to about the same extent as the north pole of a magnetic needle. This important discovery was followed by one made by Mairan, that the crown of the northern lights lies in the (prolonged) direction of the dipping-needle; and soon after this Hjoter, in Upsala, demonstrated the influence of the aurora on a magnetic needle placed horizontally (1741).

It was by these discoveries that the relation between northern lights and magnetism was established. Winkler (1746) and Van Marum (1777) compared the former to the electric glow which can be produced in rarefied air. The veil of the mystery had been raised, but only to disclose a new query, for the demonstration of the cause of these relations was a problem the solution of which was reserved for modern science. How far the efforts in this direction have been crowned by success we are now to consider.

Auroras are most frequently seen in the cold and in the northern temperate zone, rarely in the southern temperate zone, and hardly ever in the tropics. The places where they most frequently appear lie between the sixtieth and seventieth degrees of north latitude. In the form of an oval, they include the geographical as well as the magnetic north pole, which is to be found on the peninsula Boothia Felix, Iceland, the Kara Sea, northern Siberia, Bering Strait, Hudson Bay, Labrador, and Greenland. Northern lights have been seen as far down as the twenty-fifth degree of north latitude. In full splendor, however, they may be seen only in the northern polar regions to the seventy-fifth degree of latitude. Here Nature is displayed in all her grandeur. When the sun has set, and the gray veil of twilight is cast over the earth, the northern horizon grows darker and darker. Soon there may be distinguished a segment of the sky more somber than its background; this is hemmed in by white concentric arcs of light.

Colored rays shoot forth therefrom in all directions. They interlace and intertwine until they seem to be woven into one fluttering band of color. And anon it changes to a sea of fire! The rays leap upward far above the zenith, form there a flaming crown, and then sink back, to begin anew the wondrous play. The most beautiful descriptions and trustworthy observations we owe to Nordenskjöld and Ekama. All explanations which have been attempted as to the origin and the cause of northern lights are based on analysis by the spectroscope, on the determination of the elevation, and on observations of the peculiar behavior of the magnetic needle.

If northern lights are observed through a spectroscope, a characteristic yellowish-green line will always be seen, no matter how faint the light may be. If the phenomena are well pronounced, several red lines appear in the spectrum. What inferences may be drawn from these observations?

If a very powerful electric current is sent through what is called a Geissler tube filled with dried and rarefied air, sparks will flash from one platinum wire to the other, and if these are examined by the spectroscope they show the characteristic yellowish-green line. In a tube filled with nitrogen these lines are especially well pronounced. As nitrogen is the predominant constituent of the air, we infer the northern lights to be a phenomenon similar to the glowing of the electric spark in dry and rarefied air, in which oxygen and nitrogen are the sole conductors of electricity. If white sunlight is caused to shine on a solution of chlorophyl (the green coloring matter of leaves), it shows a blood-red color. This phenomenon, when the reflected light appears of a different color from that which is transmitted, is termed fluorescence. Electric light possesses to a marked degree the property of calling forth fluorescence, as can easily be demonstrated by various experiments. It may hence be assumed that the red lines in the spectrum of northern lights are due to the fluorescence of oxygen in the upper layers of air, caused by powerful electric discharges.

The determination of the elevation of northern lights serves to confirm the foregoing conclusions, for it is a well-known fact that in the higher regions of the atmosphere the air is dry and rarefied. The height of the auroral crown has been found to be five hundred kilometres, the lower boundary being about seventy kilometres.

Of greater importance for ascertaining the true nature of northern lights has been the demonstration of the relation these phenomena hold to terrestrial magnetism, a mysterious power of which our globe is the conductor. Powerful magnetic currents appear suddenly and disappear as quickly, and we are not able to name the cause of their existence.

Like a vast ocean the magnetic force is constantly surging through our globe, here appearing, there receding, but forever seeking to attain its equilibrium. The instrument by which these occurrences are observed is the most simple conceivable — the magnetic needle. It is known that the direction and the inclination of the needle point out the magnetic location of a place. From its movement the degree of magnetic attraction of any point may be accurately determined. If sudden deviations and fluctuations of the needle occur, this evidently is an indication that the magnetic condition of the earth has been disturbed. If such variations always occur simultaneously with the appearance of northern lights, this is to be regarded as proof that an intimate relation exists between these phenomena and terrestrial magnetism. Strong northern lights, in fact, exert so great an influence on the magnetic condition of the earth, that the appearance of the phenomenon in some northern latitude may be inferred from the sudden oscillations of the needle in places where the lights are not visible. But the most striking connection between terrestrial magnetism and northern lights is shown by the position of the light-crown in the heavens. The center of this is always to be found at that point where the dipping-needle, if prolonged, would meet the aurora. The rays emanating from the arc have the direction of the earth's magnetic power; they are therefore parallel, and only apparently converge to a point. The crown of light has in truth no fixed place in the heavens, but like the rainbow its position depends on the point from which it is observed, and thus moves with the observer. But the dipping-needle in every place points to the center of the crown.

It may hence be asserted that the northern lights hold an intimate relation to the changes of terrestrial magnetism as indicated by the oscillation of the needle, and that both phenomena must have one and the same cause. The explanation of this cause has been sought in various ways, but an interpretation which would be universally accepted has thus far not been advanced. One of the first attempts to solve the problem was made by the physicist De la Rive, of Geneva, in 1862. It was based on an experiment devised by him, in which he attempted an imitation of these phenomena on a small scale. He held that vapors charged with positive electricity rise into the higher regions of the atmosphere, while the earth remains charged with the negative fluid. When the vapors are driven by the trade-winds to the poles, as soon as the tension is sufficient to overcome the non-conducting property of the air, which like an insulator lies between the earth and these vapors, the positive and the negative electricity come together. This process is accompanied by the appearance of light. The earth and the upper layer of the atmosphere must hence be regarded as an electrical condenser, with the lower layers of air as the separating medium. An actual proof that the northern lights are caused by electric currents in the atmosphere was attempted by Lemström in 1883. He covered the plateaus of two mountains in northern Finland with a network of copper wires raised several metres above the ground and provided it with hundreds of metal points. The whole was insulated and connected with a zinc plate buried in damp ground in the plain below. A continuous electric current from the air to the ground was noticeable, and a light which appeared hovering over the metal points showed, when examined by the spectroscope, the characteristic line of the auroral spectrum.

The theories, however, according to which the northern lights are a flowing together of terrestrial and atmospheric electricity of opposite kinds, leave unanswered the question as to the origin of these electric fluids. As no adequate cause could be found on the globe for such a tremendous evolution of electricity, attention was directed to the sun as the source of it all. Why should not Helios, the giver of all light and life of our world, be as well the creator of that inexhaustible force of nature that is revealed in the splendors of the northern lights?

As the endless supply of light and heat which is radiated into space by the sun, is accounted for by the contraction of that body, this may also be assigned as the cause of the stupendous generation of electricity. According to the theory of Kant and Laplace, the sun and other heavenly bodies are assumed to have been formed by the condensation of vapors which originally filled all space. This condensation is still going on in the sun in consequence of the enormous radiation of heat into space, and with it the consequent contraction.

Possibly also there might be suggested as a cause the cooling process which the sun is undergoing. It may be assumed, too, that vast amounts of electricity are hurled into space with the ignited masses of gas, whose eruption from the sun may be constantly observed. But it is more probable that the sun acts upon the earth by induction. Try the following experiment: Two insulated spheres are placed near one another, but without being in contact. On one of these spheres a bar of metal is placed, to which there is fastened a screen made of some good conducting material. If one of the spheres is charged with a certain kind of electricity, say, for instance, negative electricity, the opposite kind—in this case positive electricity—will, by induction, be generated on the other sphere. A corresponding amount of negative electricity will in the mean time be discharged on to the screen. An action similar to this may be assumed to be going on between the sun and the earth.

The sun's electricity, which may be assumed to be negative as account of the preponderance of metal in the composition of that body, generates positive electricity on the earth by induction, while the negative electricity passes over into the atmosphere surrounding the earth. The constitution of the air at different times and at different places favors this process more or less. The conducting metallic rod of our electrical experiments may be considered here as being replaced by mountain-peaks projecting high into the air.

If the equatorial currents, already mentioned by De la Rive, are borne in mind, it is evident that the air at the poles must be highly electrified, and that an exchange must then and there take place between the negative electricity and the positive (induced) electricity. This exchange gives rise to phenomena of light identical with those observed as northern lights at the north pole and as southern lights at the south pole.

This theory is strengthened by the observation that northern lights are closely connected with the appearance of sun-spots and protuberances on the sun. Already in former times a certain periodicity of northern lights was noticed. Besides the annual period in which they appear most frequently at the times of the equinox, and least frequently at the times of the solstices, a period of eleven years has been observed, corresponding closely to that of the sun-spots, the maximum of which coincides with the maximum of northern lights.

The appearance of sun-spots and protuberances, the connection between which was pointed out by Tacchini in 1885, may be regarded as signs of changes occurring on the sun, probably involving increased combustion.

This increased activity must influence the induced terrestrial electricity, and in consequence also the phenomena of northern lights. The variations and declinations of the magnetic needle, moreover, give indubitable proof of the connection between the periods of sun-spots and the electrical condition of the earth.

It should not seem strange that the terms electric and magnetic condition have been here used as synonymous. Since Oersted's discovery of the influence of the electric current on the magnetic needle, and Ampère's theory of magnetism, electricity and magnetism are regarded as merely two different forms of one and the same force of nature.—*Translated for the Popular Science Monthly from Ueber Land und Meer.*

PROF. FLOWER expressed the opinion, in his presidential address before the British Association, that an impartial survey of the recent progress of paleontological discovery must lead to the conclusion that the evidence in favor of the doctrine of a gradual transformation of living forms is steadily increasing.

DRAGONS, FABLED AND REAL.

By M. MAURICE MAINDRON.

THE geological age of reptiles was marked by various curious, seemingly only partly perfected forms, which appear to have passed away without leaving any permanent descent. To it belong the relics of those flying reptiles, the *Rhamphorhynchus* and the *Pterodactyls*. The type of the pterodactylean wing was not at all like that of the wings of birds, which were yet to come, and were beginning to appear when the reptilian era approached its close. The apparatus for flying was not formed by any essential modification of the limbs, but rather, like that of the bats, was constituted by a broad fold of the skin, attached to and sustained by the digits of the fore-limb. The last or outer digit, greatly elongated, formed a rigid side bordering and sustaining the parachute, which was further attached along the full length of the arm, and in the *Rhamphorhynchus* was continued to the tail. These animals also had a long tail ending in a membrane, sustained by rigid ribs, that served as a kind of rudder.

There were giants and dwarfs among the pterosaurians. Of the former were the *Pteranodus*, of the Kansas Cretaceous; and of the latter, little Jurassic pterodactyls, which were not larger than a lark.

The hieratic traditions of dragons appear at first sight to have been inspired by the singular forms of these monsters; and it would be easy enough to suppose that the simple-minded figure-makers of the middle ages were acquainted with the pterosaurians, and patterned after them in sculpturing the dragons and griffins which they set up at church entrances. But they did not. Man's imagination is always capable of associating different forms into individuals, and even of inventing new forms. That the dragons of art were such inventions is proved by the awkward attachments which the artists affixed to their strange conceptions. Some of their creatures, if living, would have had a hard task to fly with the wings they gave them; and others would have been greatly embarrassed to make use of all the appendages with which a hand more lavish than wise had endowed them.

Movement by flying, the realization of which is still only a dream for man, has had a charm for the mystics of all ages. All religions concur in the common fancy of putting wings on the shoulders of their gods, genii, cherubim, angels, and seraphim. There were necessary for the transportation of such forms, for company and service, and to do battle for them, animals having forms likewise supernatural and agile; whence hippogriffs, chimæras, and dragons. St. Michael the archangel, with the wings of a bird, lies low and slays the fallen angel Lucifer, having bats' wings. Dragons have also had their contests with saints. St. George defeated a monstrous dragon; other holy personages followed his example, and the times became very hard for *gargoyles, tarasques,* and *guivres.* Many of the dragons were slain, and an old monkish chronicle tells how the skin of one of them was hung from an arch in a church. The historians and wise men of antiquity did not forget to describe these monsters. Pliny speaks of a precious stone, called *dracontias,* which could only be found in the head of a dragon. St. Augustine informs us that "the dragon often rests in his den; but whenever he feels the moisture of the air he is able to rise on his wings and fly with great impetuosity." Other authors exhibit dragons ejecting fire and smoke from their burning throats, and enveloping in flames the audacious enemy who ventures to attack them. Such fables found credence as late as the sixteenth century. Even the grave Gessner believed in the existence of these creatures, and has said: "Numerous dragons are found in Ethiopia, a fact to be attributed to the heat that prevails in that country. They are also to be found in India and Libya, where they reach a length of fifteen feet, and the thickness of the trunk of a tree; but they are generally larger in India than in any other country. Two kinds of dragons are known: those that live in the mountainous country are large, alert, and swift, and have a crest, while those that live in marshy regions are sluggish and idle. The former have wings, and the latter have not; some have feet, and can get rapidly over the ground. Their vision is sharp, their hearing delicate. They rarely sleep, and for that reason the poets have made them guardians of treasures that man can not get. Near their abodes the air is noisome with their breath, and rings with their hissings."

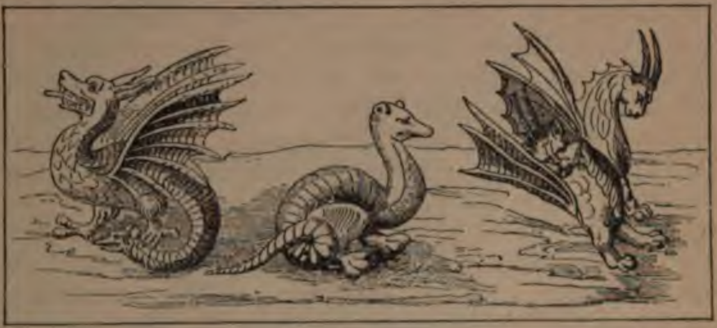
FIG. 1.—WINGED DRAGONS. (From a MS. of the Fourteenth Century. Book of the "Wonders of the World.")

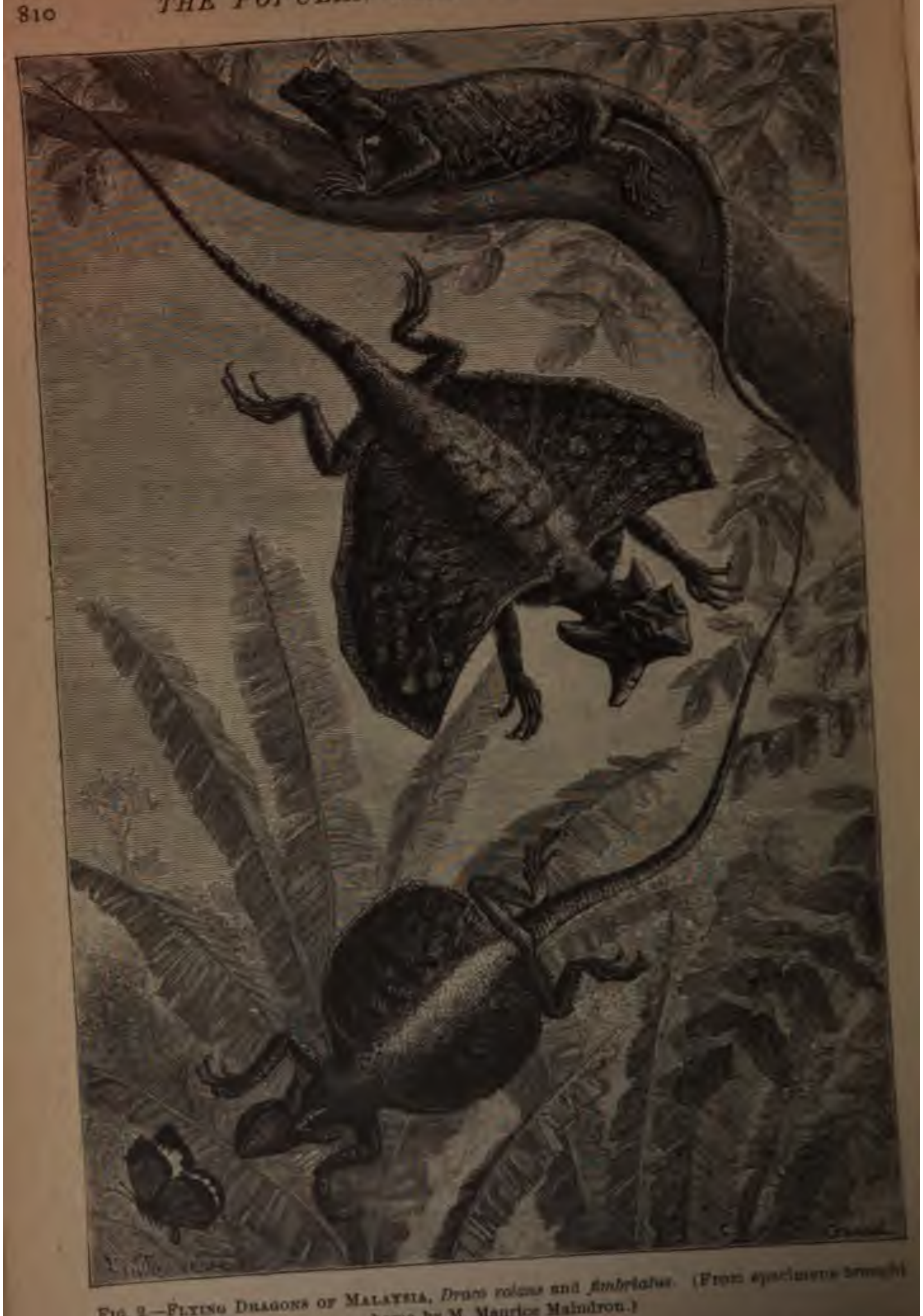

FIG. 2.—FLYING DRAGONS OF MALAYSIA, *Draco volans* and *fimbriatus*. (From specimens brought home by M. Maurice Maindron.)

These wonders, like other things of the kind, have had their day. The only dragons with which science now concerns itself are the little saurians, which are classed by some naturalists with the acrodont iguanans and by others with the agamians, and of some of which we give representations.

There live in the forests of India, the Malay Archipelago, and the Philippine Islands, lizards, whose speckled dress and odd forms have long made them objects of interest to collectors. They live exclusively on insects, which they hunt with extreme agility of pursuit along the trunks and among the branches of trees. In whatever spot they may be hiding, their variegated liveries of gray and brown, speckled with black, yellow, or green, mask them effectively and cause them to pass unperceived in the cracks or among the inequalities of the bark. Squatting under this cover, they await the coming of some insect within reach of them; or they may be seen running rapidly and suddenly covering considerable space, by a kind of flight, to place themselves upon another tree or fix themselves near a vine. Nature has been, in fact, pleased to facilitate the movements of these lively and graceful beings by an ingenious artifice. By the aid of their parachute, dragons can execute leaps in the air of considerable length, and pass from one tree to another as if by flying. But it must not be supposed that they can fly after the manner of birds. They can descend rapidly, describing a large parabola, sometimes almost a horizontal, but can not fly upward.

I have frequently observed these pretty little saurians in Java. The first time I saw one I succeeded in shooting him with a small-bored gun loaded with fine shot. When I picked my victim up I was somewhat surprised to find that I had a dragon; for its jerky and irregular flight along a large tree had caused me to suppose that it was some kind of a grasshopper or moth, which I could not get in any other way than by shooting.

The dragons, as Cuvier says, fly by means of their ribs. Their first six pairs of false ribs, instead of being attached to the sternum, are drawn out and prolonged, so as to constitute the framework of a kind of umbrella, the covering of which is formed of a wide membrane making a fold in the skin of the flanks. This membrane is independent of the limbs. When at rest, it is folded up along each flank; but it can be quickly unfolded and spread out in case of need. The name *patagium* has been given to it. The head and neck are ornamented with crests and dewlaps, often variegated with brilliantly defined colors; and a long tail gives them a singular gait which is not without grace.

The harmless little flying lizards inhabit forests and garden trees; and nothing is more amusing than to watch their manœuvres, when, not aware that they are observed, they execute their gambols in the full flush of freedom. Running swiftly along the trees, stopping instantaneously, snapping up an insect or retiring disappointed after they have missed it; pursuing one another; inflating their dewlaps and depressing their crests when enraged, they fly away spasmodically to drop a few yards farther along, down upon another tree, along which they continue their evolutions. In some dragons the tympanum is visible, in others it is hidden by a fold of the skin. A special genus (*Dranunculus*) has been constituted for the latter, while the former compose the genus *Draco*. This genus is represented by six species, of which three inhabit the island of Java; one, recognizable by its vertical nostrils, is peculiar to continental India; the fifth is native to the island of Timor; and the sixth is found at Pulu Penang. The *Dranunculus* inhabits Amboyna in the Moluccas, Celebes, and the Philippine Islands.

The dragons are the only existing reptiles that possess organs of aerial locomotion. Other saurians have folds of skin along the flanks; but in no other of them is this disposition so developed as in a curious geckotian, the *Ptychozoon homacephalum* of Java and other Sunda Islands. A broad membrane extending from the temples to the tail, where it is divided into slit lobes, is broadened along the flanks. Without reaching the dimensions of the *patagium* of the dragons, or possessing its rigid supports, it represents a kind of parachute, the importance of which may have been augmented by long use; or else we may regard these extensions of the skin as survivals of a provision which sedentary or profoundly changed habits have rendered useless.

It may be added that the livery of the *Ptychozoon* is of such a nature as to assure it all the advantages of protective resemblance. The green color, yellowish on the upper side of the body, greenish along the flanks, varied with brown lines or transverse brown fasciæ, constitutes a general tone which becomes, with wonderful ease, confounded with the bark and parasitic plants with which the trees are covered where they pass their lives.—*Translated for the Popular Science Monthly from La Nature.*

[To this account of these interesting animals we add a portrait of the frilled lizard (*Chlamydosaurus Kingii*), which possesses an appendage of different structure from the wings of the dragons, but at the first view reminding one of them. The frill, which is its conspicuous ornament, is covered with scales and is toothed on the edge. It does not come of full size till the animal is grown, and increases—according to Wood—in regular proportion to the age of the owner. In the young it does not even reach the base of the fore-limbs, while in the adult it extends well beyond them. M. F. Mocquard, who observed one of the animals during several weeks, is of the opinion that it serves the lizard as a kind of parachute, sustaining it during its

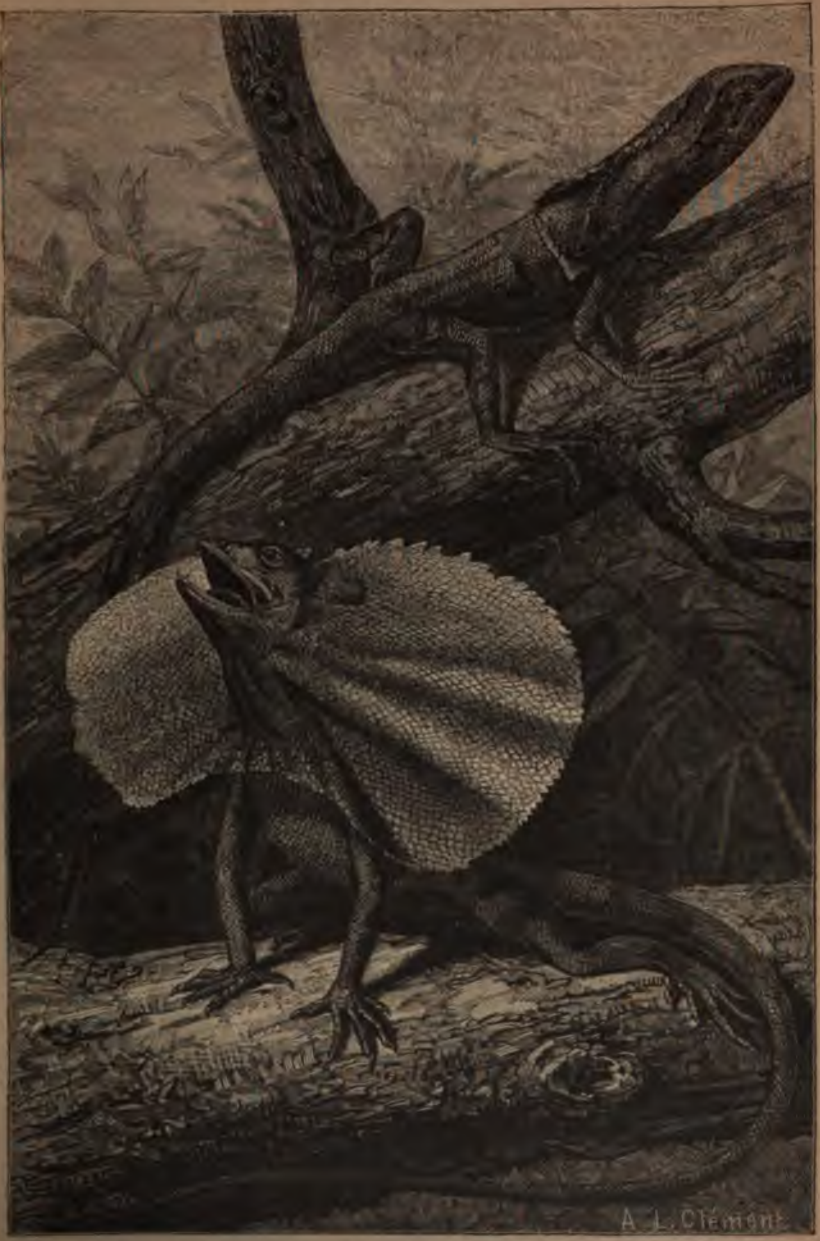

FIG. 3.—THE CHLAMYDOSAURUS. (From a specimen in the Reptile Menagerie in the Museum of Natural History in Paris.)

leaps. It is essentially a tree-inhabiting animal, though it can run very swiftly along the ground. According to Captain Grey, who observed it in nature, "when not provoked or disturbed it moves quietly about, with its frill lying back in plaits upon the body; but it is very irascible, and directly it is frightened it elevates the frill or ruff and makes for a tree, where, if overtaken, it throws itself upon its stern, raising its head and chest as high as it can upon the fore-legs, then, doubling its tail underneath the body, and displaying a very formidable set of teeth from the concavity of its large frill, it boldly faces an opponent, biting furiously whatever is presented to it, and even venturing so far in its rage as to fairly make a charge at its enemy." M. Mocquard says it is quite inoffensive. It is nearly three feet in length, including its very long tail, is of a tawny color, with mottles on the back and blackish rings on the tail. The teeth on its fringe have white ends, and at a distance look like pearls. It belongs to the family of the agamians, and is represented only by a single species, in Australia.—EDITOR.]

ALCHEMIST'S GOLD.

BY M. A. DE ROCHAS.

"THE definite and unchangeable existence of sixty-six distinct elements, as we regard them now, would assuredly never have occurred to an ancient philosopher, or rather would have been dismissed by him as ridiculous: it had to be imposed upon us by the incontestable force of the experimental method. Is this, then, the final limit of our conceptions and hopes? Not at all; for really this limit has never been accepted by chemists except as a present fact, which they have always hoped to pass by."

This paragraph, quoted from Berthelot's "Origins of Chemistry," explains why so many distinguished men have spent their days in seeking the transmutation of metals. Did they find it? Excellent minds assure us that they did not, because, in spite of the infinitely more powerful forces we now have at our disposal, we have not been able to decompose any metal. Others maintain that the reasoning is not conclusive; for numerous industrial processes have been lost, and we knew how to convert alcohol into vinegar long before we could analyze either substance; and there is one element—time—which the moderns, with their intensive life, can not use as their predecessors did. Where is the man now who would bind himself down for years to make the projecting powder or the philosopher's stone—representing the hypothetical ferment of inorganic substances—or who could count enough upon the future to bequeath the continuation of his experiments to his heirs, as did the adepts of old?

There have been many alchemists who, notwithstanding the satirical definition of their art—"*Ars sine arte; cujus principium mentiri, medium laborare et finis mendicare*" ("An art without art; the beginning of which is to lie, the middle to work, and the end to beg")—have acquired considerable wealth, the source of which it is hard to divine in any other way. M. Louis Figuier has collated the stories of the principal of them in his "History of Alchemy." I purpose in this article to describe some medals which were struck from gold which was said to have been compounded. I have seen one of the pieces, and tried to buy it for purposes of analysis, but the holder would not sell it. Probably an interesting collection might be made of such medals.

In 1312 Raymond Lulle went to the British Islands in an effort to induce Kings Edward III and Robert Bruce to engage in a crusade, and promised to pay all the expenses of the expedition by means of his art. King Edward, more concerned about making gold than about going to the Holy Land, furnished the alchemist with a laboratory in the Tower of London; and there Raymond, according to a declaration in his will, at a single operation converted fifty pounds of mercury, lead, and tin into "gold." This "gold" was used in striking "rare nobles," some of which weighed as much as ten ducats, and must, therefore, have been as large as a French hundred-franc piece. Under the name of Raymond's nobles, they have been much sought for by English collectors.

King Henry VI granted to several alchemists the right of making gold and silver out of the base metals. The products of their industry were probably used for coining the false money, the emission of which provoked prohibitory measures from the Scotch Parliament. Conrad Barchusen, a Dutch chemist of the beginning of the eighteenth century, assumed that the "gold" of Henry VI was obtained by putting mercury and sulphate of copper in an iron crucible with a little water. The copper, set free by the action of the iron, formed with the mercury an amalgam which, washed and pressed to drive out the soluble substances and the excess of mercury, gave on fusion a metal having the color of gold, but lighter, and readily taking the impress of the die.

At about the same time, Barbe de Cilley—wife of the Emperor Sigismund of Germany—pretended that she had found the philosopher's stone, in order to make her subjects accept an alloy of copper and arsenic for silver, and an alloy of gold, copper, and silver for gold. The alchemist Jean de Laaz solicited from her the privilege of being present at one of her transmutations. He detected the cheat, and was simple enough to reproach her Majesty for having bungled; and for this he barely escaped going to prison.

Jacques Cœur obtained from Charles VI of France, in consideration of his possession of the secret, power to coin money of "silver," some of the pieces of which were described by De Planis Campy as still existing in 1633. They bore his name and the three hearts of his arms.

Monconis * tells of a merchant of Lubeck who transformed lead into a hundred "gold" livres in the presence of Gustavus Adolphus, King of Sweden; and who furnished the gold from which ducats were coined, bearing on one side the figure of the prince, and on the other side his arms, associated with alchemic symbols, in recollection of the origin of the metal. The merchant died some years afterward, leaving an enormous fortune, although his trade had been insignificant.

Christian IV of Denmark, in 1646, appointed as "alchemist to the king" Gaspar Harbach, who made him some "gold," from which were coined medals bearing the inscription "*Vide mira Domini* ('Behold the wonders of the Lord'), 1647," beneath the sign O—O, designating mercury.

An Austrian named Richtausen, in 1648, received as a bequest from one of his friends a casket containing precipitating powder; with a grain of this powder, the Count de Rütz, director of the mines of the empire at Prague, in the presence of the Emperor Ferdinand III and the absence of Richtausen, transformed three livres or six marks of mercury into five marks of "gold." Rodolph had struck in this "gold" a medal which still existed in the Treasury at Vienna in 1797. It represents the god of the sun carrying the caduceus and having wings on his feet—all by way of reminder of the formation of "gold" by the aid of mercury.† In 1650 the emperor made a second precipitation at Prague, from lead; and the medal struck on this occasion bore the inscription "*Aurea progenies plumbo prognata parente*" ("Golden progeny of a lead parent"). This medal was still shown in the last century, in the collection of the Château d'Ambras (Tyrol). Richtausen received for his discovery the characteristic title of Baron of Chaos.

General Paykhul, in 1706, made for King Charles XII of Sweden, with lead and a few grains of his powder, under the surveillance of artillery-general Hamilton and the chemist Hieme, a mass of "gold" sufficient for the coinage of one hundred and forty-seven ducats; a commemorative medal, struck on the occasion, from the same "gold," weighed two ducats and bore the inscription "*Hoc aurum arte chimica conflavit Holmiæ* 1706, *O. A. V. Paikhull*" ("This gold O. A. V. Paikhull produced by chemical art at Holm in 1706").

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* "Voyage d'Allemagne."

† Arsenic (*το ἀρσενικόν*, the male) was one of the first substances tried for the purpose of transmutation. Its vapors whitened copper (which was considered a female element, was dedicated to Venus, and was represented by the sign ♀), forming an arseniuret; and this change was for a long time regarded as the beginning of transmutation.

In 1704 a goldsmith of Lubeck, named Stolle, received a visit from a stranger, supposed to be the celebrated adept Lascaris, who, after a discussion respecting the transmutation of metals, left with him, as a proof of the possibility of the operation, an ingot weighing about a half-livre, which he said he had just made; he asked Stolle to treat it with antimony to purify it, heat it, and cut it into seven pieces. He then left two of the pieces with the goldsmith as a souvenir, and added eight ducats. One of the pieces was given to King Augustus of Poland, and the other was deposited in the collection of medals at Lubeck. They bore the inscription "*O tu . . . philosophorum*" ("O thou . . . of philosophers!"), which the adept had had engraved by the goldsmith.

A Provençal locksmith, named Jean Troins, who called himself the Sieur Delisle,[*] fabricated in the presence of M. de Saint-Maurice, president of the mint at Lyons, and at the Château Saint-Auban, two ingots of "gold," one from mercury and the other from lead. On trying to strike medals from this preparation at Lyons, the minter found it "so hard that it was not possible to work it." It was then sent to Paris, to the controller-general of finance, who had a number of medals struck from it bearing the inscription "*Aurum ex arte factum*" ("Gold made by art"). One of the medals was deposited in the Royal Cabinet, and, according to Langlet-Dufresnoy, its allotted square was still existing at the mint in 1762. I have handled and have an impression of a piece which, although the inscription is not identical with that described by Dufresnoy, was most probably made from Delisle's metal.[†] Its density is perceptibly different from that of gold, and that should give it a place in the class of tokens without value. Some spots of verdigris disappeared under the action of nitric acid, which did not attack the rest of the metal. Delisle likewise made, under similar circumstances, but with a different powder, an ingot of "silver," from which two crowns, two half-crowns, two quarters, and three ten-sous pieces were struck.

In 1717 Landgrave Ernest Louis of Hesse-Darmstadt, who was an amateur alchemist, received by mail a little box containing two packages of powder, one red and the other white, with directions for using them. He was thus able to enjoy the pleasure of himself changing lead into "gold" and "silver." From the "gold" he struck a few hundred ducats, bearing on one side his name and effigy, and on the other the lion of Hesse and his initials, E. L. From the "silver" he struck a hundred thalers bearing his name and likeness on one side, and on the other the inscription "*Sic placuit Deo in tribulationibus*" ("Thus it has pleased God in tribulations"), 1717, with the lion of Hesse and his initials, surrounded by four crowns.

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[*] Delisle is accused of having been the servant of Lascaris, and of having assassinated him in Savoy, in order to steal his powder. After this crime, in 1706, he established himself at Sisteron, where he married and soon achieved a great local notoriety by changing nails, knives, shoe-buckles, rings, etc., of iron and steel into "gold" or "silver." Some of these transformed objects might, perhaps, still be found in the country if one should be at the pains of searching for them. Delisle resided in succession at Sisteron, the château of Palud Digne, where he is said to have enriched a merchant named Taxis; at Castellane, and at Senéz, where he performed several times before the bishop.

[†] Possibly, however, this was a mock token, like those which were struck in England in 1816, when Napoleon was sent to St. Helena. That token was just like a twenty-franc piece, and bore the figure of the emperor on one side and a ship on the other, with the inscription "This is copper."

These operations made so much stir that the Academy of Sciences was moved by it; and in 1722 the chemist Geoffroy was charged to demonstrate to the learned company that these extraordinary achievements were a pure fraud. In the report, which he read on the 15th of April, he said: "Since the main intention of the operators is usually to show gold or silver in the place of the minerals which they pretend to transmute, they sometimes use double crucibles or cupels, or they put salts of gold or silver in the bottom of them; they then cover the bottom with a paste made by mixing crucible-dust with gum-water or wax; doing it so that this false bottom shall seem to be the real bottom. At other times they put gold or silver dust in a hole made in a piece of charcoal; or they saturate charcoal with solutions of those metals and then reduce the mass to a powder, in order to project it upon the substances which they are going to transmute.

"They use rods with hollowed ends containing in the cavities gold or silver filings, and stopped up with sawdust of the same wood. Stirring their molten matter with these rods, the sticks burn, leaving in the crucible the metal with which they have been charged. In an endless variety of ways they mix gold or silver with the substances with which they work. A small quantity of gold or silver will not show in a large quantity of such metallic substances as the regulus of antimony, lead, or copper. Salts of gold and silver can very easily be mixed with salts of lead, antimony, and mercury. Grains or nuggets of gold and silver can be inclosed in lead. Gold may be whitened with quicksilver and made to pass for tin. The collection of gold and silver from the substances with which they have been mixed may be made to pass for transmutation.

"All that goes on in the hands of these people should be watched. For the *aqua fortis* or *aqua regia* which they use is often already charged with solutions of gold or silver. The papers in which they wrap their chemicals are sometimes loaded with salts of these metals; and the pasteboards they employ may conceal such salts in their thickness. Glass has been known to come out from furnaces charged with portions of gold which had been admittedly slipped in while it was molten.

"Some alchemists have imposed on their spectators with nails half of iron and half of gold or silver. They make believe that they effect a real transmutation of half of these nails by dipping it into a pretended tincture. Nothing is more seductive at first; but it is, after all, only a trick. The nails, which seemed to be all iron, were really in two pieces neatly soldered, the gold or silver to the iron, and washed with an iron-colored wash, that disappeared when they were dipped into a suitable liquid. Of this character was the gold and iron nail formerly to be seen in the cabinet of the Grand Duke of Tuscany; of like nature are those half-silver and half-iron nails which I present to this society today. Such also was the knife which a monk once presented to Queen Elizabeth of England, in the earlier years of her reign, the end of the blade of which was of gold; as well also those knives, half silver and half iron, which a famous quack scattered a few years ago over Provence. It is true that they say that this last performer operated on knives that were given him, and which he gave back after a time with the ends of the blades silvered. But there is reason for supposing that the change was made by cutting off the end of the blade and soldering on a similar end of silver.

"There have been also pieces of money and medals half gold and half silver. Such pieces were said to have been originally all silver, half of which was turned into gold by dipping them half-way into the philosopher's mixture, without the outer form or the engraved designs being essentially changed. I say that no such medal was ever all silver, but that they were in two pieces, one of silver the other of gold, so soldered together as to preserve the proper arrangement of the characters. The thing could be easily done by having several silver medals of the same kind, a little worn, and making molds of them in sand for casting copies in gold. The sand would not even have to be very fine. Then let the medals be cut exactly to rule, fitted by filing, and the complementary halves soldered together with care, to have the designs precisely correspond. Any trifling flaw could be mended with the graver. The part of the medal that is of gold, having been cast in sand, looks a little grainy and is rougher than the silver part, which was pressed; but this fault was given out to be an effect or a proof of the transmutation; because a given quantity of silver, having a larger volume than a like quantity of gold, the silver shrunk some in changing into gold, leaving the pores or spaces that constituted the grain. The operator, besides, took pains to make the golden part a little thinner than the silver, to keep up the semblance; and to use only as much or not quite as much gold as there was of silver. A second medal was prepared in the same way.

"They also took a silver medal, filed down one half of it on either side, without touching the other half, till they reduced it to about the thickness of a playing-card. Then, taking half of a medal of gold, they split it, and reducing the two parts in the required proportions, adjusted the outside parts over the silver core, preserving the proper arrangement of the designer. They then had a whole medal, half silver and half gold, but with the gold part stuffed with silver. This, they said, was a silver medal which had not lain long enough in the elixir, and had only been partly transmuted.

"Half of a third medal was superficially gilded with an amalgam of gold, and represented a piece which, having been merely dipped into the elixir, had only begun to turn.

"When this game was played, the golden parts of the three pieces were whitened with mercury, so as to look as if they were all silver. To make the deception more complete, the performer, who should have a knack for conjuring, exhibited three genuine silver pieces that had not been tampered with, and permitted the audience to examine them. Taking them back, he slyly substituted his prepared pieces for them; fixed these in his glasses, poured in as much of his elixir as suited him, and withdrew them at the lapse of the designated intervals of time. He threw them into the fire and left them there long enough to drive away the mercury with which the gold was masked. Then he took them out, looking as if they were half of silver and half of gold; but with the difference that, in cutting the parts that seemed to be of gold, one was merely gilded on the surface, another was gold filled with silver, and the third was gold all through.

"Chemistry furnished these tricksters with other most subtle means of carrying out their deceptions. It was also possible to introduce another, lighter metal into gold, which, while reducing its weight to that of an equal volume of silver, would not change its color, or separate from it in any part of the process."—*Translated for the Popular Science Monthly from La Nature.*

Many very curious features of language are exhibited in Dr. Leitner's book on the Hunzas of Dardistan. The substantive can not be used without the personal pronoun; as if we could say "my heart," "thy heart," or "his heart," but not "heart" by itself. The plurals of many feminine nouns are masculine, and *vice versa.* In the verb "to be" or "to become," as well as in numerous other verbs, there are different plurals for men, women, animals, etc., and the latter are again subdivided according to sex. Objects also are distinguished into male and female, according to their fancied stronger or weaker sex.

A LESSON IN CO-OPERATION.

BY CLARENCE N. OUSLEY.

THE commercial method of the times seems to be the merging of competing enterprises into syndicates and trusts under a single management. Naturally enough a similar tendency is becoming manifest among producers as well as among manufacturing and transportation agencies. Various meetings and conventions among farmers of late have suggested the establishing of co-operative stores and exchanges controlled by a central bureau, which shall be the head of a gigantic farmers' pool. Indeed, the first steps to this end have already been taken in several Southern and Western States. In view of the event to which these signs point, it is not amiss at this juncture to interpose a lesson in co-operation furnished by the rise in 1887 and fall in 1889 of a large enterprise of this sort, viz., the Farmers' Alliance Exchange of Texas. It is not the purpose of this paper to discuss the expediency of such commercial ventures. The intention is merely to give an historical account of the particular case under examination, without even pointing a moral further than that which would suggest itself to any thoughtful mind—viz., like causes, operating under like conditions, will produce like effects.

The Farmers' Alliance of the Southern States, which was consolidated with other farmers' organizations at St. Louis in December last into the Farmers' Alliance and Industrial Union of America, had its origin in Texas several years ago. One of its original purposes, according to the declaration of its constitution, was "to develop a better state financially" among its members; and in pursuance of this purpose the Farmers' Alliance Exchange of Texas was organized. It was the first extensive business experiment under the Alliance movement, which had meanwhile spread over the South, and was therefore watched with considerable interest. At the annual meeting of the Texas Alliance, at Waco, in August, 1887, the following plan of business was adopted: 1. To incorporate the Farmers' Alliance Exchange of Texas. 2. To sell farmers' produce and to buy farmers' supplies as the farmers' agent, and to erect suitable buildings for conducting the business. 3. The capital stock to be $500,000, divided into twenty-five shares, controlled by twenty-five trustees elected by the State Alliance. 4. To raise the capital stock by assessing each member of the Alliance two dollars, and on receipt of $50,000 to credit each share with ten per cent paid in, and like credit to be made for each subsequent payment of the same amount. The twenty-five trustees were elected, and a State business agency, previously in operation on a small scale, was merged into the new enterprise. From this time forward for several months there prevailed among the members of the order the most hopeful and enthusiastic spirit possible to imagine, amounting to almost a universal conviction that financial salvation was come.

The main body of the Alliance was composed of tenant farmers, who as a class farm on the "third and fourth," that is, by paying a third of the cotton and a fourth of the corn as rental for the land. They are possessed of little more than a meager household and farming equipment, and are generally compelled to mortgage the growing crop to the country merchant for the year's supplies of groceries, clothing, and implements. Their hope was to escape from the country merchant, who, to say the least, does not conduct his business on the plan of quick sales and small profits. To afford such escape was equally the design of the Exchange. It may be readily perceived, therefore, that the Alliance was wrought to the highest pitch of excitement in contemplation of abolishing the awful credit system which is a veritable millstone about the neck of the improvident farmer. In addition to the work of public lecturers sent out by the Alliance, several papers published in the interest of the order kept the Exchange topic red hot, while it was also a theme for discussion in the papers at large, so that the general public was in a state of greater or less expectancy. In connection with the Exchange it was announced by the Alliance organs and speakers that the movement would result finally—and not a very far off "finally" at that—in cotton and woolen mills, implement and wagon factories, a huge printing-house, etc. A plan was formulated also for establishing an Alliance University, with departments of law, medicine, and theology. From first to last several factories have been started, but without a single exception they have failed to reach the stage of successful operation.

Immediately after the Waco meeting of the Alliance, the twenty-five trustees met and delegated the transaction of business to a board of seven directors, which was organized by the election of the following officers: a president, secretary, treasurer, and a general business manager. Meanwhile a charter had been procured in accordance with the foregoing plan, and the establishment was located at Dallas, in consideration of $10,000 cash subsidy, a site for buildings, and other substantial inducements. The business was opened in September, 1887, in temporary quarters provided rent free by the citizens of Dallas. The published report of the manager for that month shows an expense account of $793.91 and a cash balance of $201.40, or total resources amounting to $991.31. This was a part of the $10,000 cash subsidy, which, though never quite paid in full, was practically discharged and furnished the available capital for some time.

The Exchange commenced business by handling cotton and grain, and farm implements. The former were sold after the plan of a regular commission-house; the latter were procured and furnished at good discounts by centering the trade direct to a wholesale dealer, who was nominally the Alliance implement agent, but in fact was selling on his own account. It was but a short time, however, until the business was extended to the buying and selling of dry goods, groceries, and general supplies.

Notwithstanding the lack of capital which appears from the business manager's reports, the Exchange was complimented by the mercantile public with a fairly good credit, and may be said to have commenced life under the most favorable circumstances. The financial statement for the forty-five days ending October 31st, is as follows:

Accounts and bills receivable	$9,962 51	
Office fixtures and furniture	202 20	$10,164 71
Liabilities.		
Accounts and bills payable	$9,511 24	
Total liabilities		$9,511 24
Net capital		$653 47
Losses.		
Expense account	$312 64	
Help account	1,588 82	
Total losses		$1,901 46
Gains.		
On bagging and ties	$79 65	
Interest and discount	1 80	
Commission account	493 41	
Merchandise	62	
Total gains		575 48
Net losses		$1,325 98
Investment	$201 40	
Received from donation, etc.	1,778 05	
Total capital	$1,979 45	
Deduct net losses	1,325 98	
Net capital		653 47

It will be observed that the September cash balance of $201.40 has been supplemented only by $1,778.05 "received from donation, etc.," which was mainly "donation" and little "etc."—that is to say, chiefly from the citizens' subsidy and almost nothing from stock subscription. The statement for November exhibits an increment of $1,122.40 from donation account, and practically nothing from stock, with a net capital of only $1,195.17, showing the business to be still operating at a loss.

a meeting of the directors, November 5, 1887, a novel plan adopted which became the central and chief feature of the institution, becoming first the means of its sudden advancement, and later the cause of its sudden suspension. It is attributed, in the minutes of the meeting, to one of the directors, but probably owes its origin to the manager, who was the controlling spirit of the Exchange enterprise from its inception to the spring of 1889—the period of his management. The plan was briefly as follows:

1. Members of each Sub-Alliance, wishing supplies on credit, to furnish a schedule of their probable needs during the year, together with a showing of their full financial responsibility, and a pledge of cotton at least three times as much as the amount of credit.

2. These several members of each Sub-Alliance to execute a joint note for the estimated amount of supplies, said note to draw interest after May 31st and to be paid November 15th.

It was designed that these notes should be signed also by responsible farmers (if necessary to make them bankable), who would secure themselves against loss by taking mortgages on the growing crops. In this way the country merchant was to be avoided.

These joint notes acknowledged full consideration in the face, and were to be credited finally with the difference between the face and the actual credit account. The notes at first were accompanied by a sort of bond of corresponding number, issued by the Exchange, agreeing not to part ownership with the notes; but, upon the failure of the order during November and December to pay in any considerable amount of the capital stock, the available donation being then about exhausted, the notes were, by order of the board of directors in January, used as collateral security in borrowing money.

The business manager's report for the month ending January 31st showed $4,157.36 increase of capital during the month, or a total of $5,247.93. The months of January, February, and March constituted a period of great activity. The country was alive with lecturers in the joint employ of the State Alliance and the Exchange; "The Southern Mercury," organ of the order, had an extensive circulation, and the Exchange was issuing a semimonthly circular letter containing private advice, discounts, etc. During this time the total capital was increased to $20,215.38; the amount of joint notes reached $200,974.88, on which goods had been advanced to the amount of $108,371.06.

An extract from the business manager's report for the month of March shows "the beginning of the end," the first embarrassments that soon culminated in a serious, not to say fatal, collapse:

"The business manager spent the whole of the month of March in trying to negotiate banking arrangements whereby a loan could be effected at a reasonable rate of interest, to provide funds to purchase goods with which to supply the contracts accepted by the committee of acceptance; but all the efforts made were unsuccessful, and tended to produce the conviction that those who controlled the moneyed institutions of the State either did not choose to do business with us, or they feared the ill will of a certain class of business men who consider their interests antagonistic to those of our order and corporation. At any rate, be the causes what they may, the effort to borrow money in a sufficient quantity failed."

The month of April showed an increase in capital, from stock paid in, of $1,526.36. During the month of May maturing obligations failed to be met, notes of the Exchange went to protest, and general disaster followed, amounting almost to a total suspension of business. During all this time the most hopeful statements were made by the manager to the public, and the general fraternity were induced by official utterances to believe that the troubles of their business were precipitated by a combination of bankers and wholesale merchants to crush it out. A meeting of the State Alliance Executive Committee was called, and, after a few days of examination into the business at Dallas, the following call, signed by the seven directors, was issued:

> *Members of the Farmers' Alliance of Texas:*
>
> BRETHREN: Grave and important issues confront us to-day. Unjust combinations seek to throttle our lawful and legitimate efforts to introduce a business system more just and equitable than is now prevailing. . . . In order that the proof of the existence of this combination may be submitted to you, and that a full, free conference may be had with the brethren, it is most earnestly recommended that a mass meeting be held at the court-house in each county of the State on the second Saturday in June, at which meeting documentary evidence disclosing facts of vast importance will be laid before you, and a plan for your consideration and adoption. . . .

In addition to this, there was issued about the same time a secret circular, signed by the officers of the Exchange, which is so violent in language as to almost merit the adjective "revolutionary." The circular is too long for reproduction here, but the main points may be summarized as follow:

> 1. There was from the first a hidden, underhanded, masked opposition to the Exchange. 2. That Dallas bankers, wholesale merchants, implement dealers, and manufacturers entered into a combination to crush the Exchange; that the bankers refused to lend the Exchange money upon any terms or any security, and tried to force them to buy through jobbers. 3. That the Dallas combination "kept the mails full and the wires red hot" to prevent the Exchange from getting money at Fort Worth, Houston, Galveston, and New Orleans.

These utterances indicate the bitterness of feeling incited by the Exchange management and the officers of the State Alliance.

While the circulars were condemned by a few conservative spirits, and were subsequently regretted, probably, by all reasonable men in the order, at that time they were not publicly disputed except by outside parties. "The Texas Farmer," organ of the Texas State Grange, went to the trouble of interviewing prominent bankers and business men in Dallas, who uniformly denied the existence of any such combination, and affirmed their good-will for the Exchange, attributing its failure to lack of business management. From the publication of these circulars, in May, to the 9th of June, the Alliance was in a state of violent excitement. In addition to the circulars and other publications, lecturers covered the entire State, and, by every possible argument and appeal, urged the members to take stock and save the business from final ruin. The effect was to raise only little less than $30,000, though subsequent fruits of the same canvass increased that amount to nearly $50,000. The statement for June shows a total capital invested of $56,409.26.

This call on the 9th of June, 1888, which became a memorable day in Alliance history, forcibly illustrates the weakness of such financial schemes as depend on popular subscriptions, or per capita assessments, with no other power of collection than the force of fraternal obligation. The membership of the Alliance in Texas had been frequently estimated by Alliance speakers and writers at 250,000, though it probably never reached more than half that number—if more, it all the more strongly illustrates the point. In speaking of the resources of the Alliance business, it was common with leaders to say that unlimited sums could be raised on call. For instance, an assessment of one dollar per capita would bring in, within thirty days, $125,000 (or $250,000, according to the highest estimate of membership). Here was a case of prime importance in which it was urged that not only the salvation of the business but the freedom of the farmer was at stake, and yet the total subscriptions, first and last, did not exceed $50,000.

Notwithstanding the disaster impending in the early spring, the board of directors at their March meeting entered into a contract for a building, to cost $34,117, which was in due time completed, though never one fourth paid for, and in April opened a branch Exchange in Belton, Texas. The Belton business received substantial inducements from citizens amounting to about $10,000.

It is unnecessary to further follow the business in detail. The June rally failed to raise the needful amount of funds to make the Exchange easy. Extensions were secured from time to time, and efforts were constantly made to raise the capital stock, but without material success. The Exchange never recovered from the wild and extravagant methods of its first winter, and in the summer and fall of 1888 it was further crippled by attacks of "The Southern Mercury," the State Alliance organ, on its business management. This caused internal dissensions which threatened at one time to disrupt the order, creating two bitter factions, which for a long time refused to be reconciled. Early in 1889 the business manager of the Exchange resigned, and a new one was elected in his stead. Meanwhile there had been a change in the editorial management of the "Mercury," and the spirit of true fraternity soon reasserted itself, the order becoming again firmly cemented, though it had lost materially in members. However, the better part remained, and the Alliance has since been happily progressing in all that relates to social and economic education.

The management of the Exchange during 1889 was conservative and judicious, and, under other circumstances, he would doubtless have made it a successful enterprise, but it was too heavily encumbered, and the confidence of the order in it had been sacrificed. His report to the State Alliance, August, 1889, is as follows:

Resources.		*Liabilities.*	
Exchange building, Dallas....	$70,000 00	Bills payable on merchandise .	$44,704 42
Exchange building, Belton ...	12,000 00	Bills payable on buildings....	29,300 00
Exchange building, Longview .	9,000 00	Accounts payable...........	1,285 81
Live stock, Henrietta........	7,500 00		$75,290 23
Merchandise, all points	50,238 00	Present net worth...........	104,557 77
Accounts and bills receivable, estimated good	39,210 00		$179,848 00
	$179,848 00		

Cash received and paid out.

Amount paid on old indebtedness..........................	$34,103 43	
Amount received from sale of lands.......................		$14,800 00
Amount received from capital stock		5,276 50
Merchandise sales and collections..........................		14,026 93
	$34,103 43	$34,103 43

Report made to directors in January showed the mercantile indebtedness to be $46,000. The real fact is that it was $78,817.85.

The State Alliance, in August, 1889, passed a resolution providing for a voluntary trust fund of $75,000, or enough to discharge the entire indebtedness of the Exchange, but not to be used until raised in full. The trust fund never reached a third of the required amount, and in December last the Exchange building at Dallas was sold under mortgage for $35,000. Immediately thereafter the manager proceeded to wind up the affairs of the Farmers' Alliance Exchange of Texas.

To recapitulate: The Exchange commenced to do business without capital, depending on donations and assessments, with no power to enforce collection. Instead of confining its operations to buying and selling as the farmers' agent, it attempted to take the place of the country merchants, and to furnish supplies on credit to all the farmers of Texas. To do this successfully would require millions instead of thousands. The reason the banks refused to lend money to the Exchange in March, 1889, was neither opposition to the Exchange nor undue friendliness to the jobbers, but plain business prudence. The Exchange was doing a larger business than its capital warranted; the joint notes used as collateral security were represented by accounts from twenty-five to seventy-five per cent less than the face of the notes, and while innocent purchasers could be protected in the courts, still litigation is a resort which every prudent business man tries to avoid; some of the joint notes were offset by bonds agreeing not to part ownership, while as a matter of fact they were placed in serious jeopardy by being put up as collateral security for extensive loans. The wisdom of these precautions was demonstrated in the final outcome of the Exchange's management.

In October last the representatives of the trust fund, which reached about $17,000, perceiving that it would be inadequate for the ends sought, met at Dallas and placed it in the hands of the manager, instructing him to save such part of the Exchange as might be possible. Since the sale of the building there has been organized a new corporation, composed of Alliance members representing the trust fund; and this new corporation, known as the Farmers' Alliance Commercial Agency, has purchased the Exchange building, and designs carrying on a general buying and selling agency. It is to be hoped that the new enterprise will be more successful than the old one was.

According to Oudeman's review of parallax investigations, the distance of forty of the fixed stars has been approximately determined. The disproportion between this number and the number of stars of which we know nothing is so great, says Mr. A. M. Clarke, that general conclusions seem discredited beforehand, and negative ones can have no weight. But it is evident that the largest stars are not always those nearest to the earth. Seven of those whose distances have been ascertained are invisible to the naked eye, while one is nearer than Sirius, and all are nearer than Capella, Vega, Arcturus, or Canopus. A further conclusion may be deduced that the disparities between the stars are enormous. "A farthing rush-light is not more insignificant compared with the electric arc than a faint star compared with a potent sun. Sirius emits 6,400 times as much light as the ninth-magnitude star 11,677 Argelander-Oelzen; and our own sun is nearly as much inferior to Arcturus. Inequalities of the same order appear between the members of revolving systems; as, for instance, Sirius shines like four thousand of his companions."

INTELLIGENCE OF SQUIRRELS.*

By Dr. T. WESLEY MILLS,
PROFESSOR OF PHYSIOLOGY IN MCGILL UNIVERSITY.

UNTIL recently, the habits of animals seem to have been considered simply as interesting manifestations of their life, but without any special reference to their relations to the intellectual part of the creatures concerned. But unless we assume that animals are devoid of mind and true intelligence—an extreme and untenable position—there must be a possible science of comparative psychology, as there is of comparative anatomy and physiology. The study of animal intelligence is possible, interesting, and important, whether we regard man as derived from some lower form, and his intellectual as well as his physical being the result of evolution; or whether we consider that man stands wholly apart in origin either as to body or mind. In the latter case, the study of the lower forms of mind affords a useful contrast with its highest development as seen in man; in the former, we aim at the construction of a ladder by which we may climb from the simplest manifestations of consciousness to the highest performances of the most gigantic human intellect.

I have selected the study of squirrel psychology as the subject of this paper, because so little seems to have been written on the subject; because these animals are open to the observation of every one; and chiefly because I have been able to give special attention to them myself. Their habits will be considered principally, but not exclusively, from the psychological standpoint; and I shall apply the comparative method, making such references to the habits and intelligence of other rodents as seem to throw light on those of the squirrel. While some attention has been paid to other species of squirrels, my studies have been chiefly on the ground squirrel (*Tamias Lysteri*) and the red squirrel (*Sciurus Hudsonius*).

These species, in many respects, form a contrast to each other. The chipmunk, chipping squirrel, or hackee, has his abode underground in a specially constructed burrow; the red squirrel, or chickaree, lives in nests in trees; and the intelligence of the latter seems to be altogether of a much higher order than in the ground squirrel. This was abundantly illustrated in my experiments with an ordinary wire rat-trap having a spring door. The trap was scarcely laid down near the haunts of the chipmunk before one entered it, in fact before my eyes; and there was never any difficulty in securing as many as were wanted. On several occasions, when one had escaped in the room, on placing a small apple in the cage, the creature re-entered it almost at once.

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* Part of a paper communicated to the Royal Society of Canada.

Very different was it with the red squirrels; at first they entered the trap, but not afterward. They approached it, sometimes two or three together, ran round it on the upper rail of the fence on which it was placed, or sat on top of it—in short, did everything but enter it—all the while seeming to enjoy the whole greatly.

Having secured a couple of ground squirrels in the manner described, I kept them under observation for the period during which they survived, viz., one for about a month and the other for between two and three months. From the first, one of them seemed to take more kindly to his new surroundings than the other; one appeared shy and dull, while his fellow seemed as happy as any chipmunk might be. They were captured in September, and it has often occurred to me that their habit of hibernation had something to do with the behavior of the one, though we should expect that, in such a matter, both would be equally or considerably affected. The degree to which, while retaining their original habits, the latter became modified in confinement, furnished me with an interesting study, and suggested many problems. My experience does not agree wholly with that of Audubon and Bachmann, who say, in their "Quadrupeds of North America," "We are doubtful whether this species can at any time be perfectly tamed." The one of my chipmunks that survived longest became in a short time so tame that he would eat from the hand, and even looked to be fed in this way. True, any noise, or any unusual movement, might startle the creature, when he would make the quick dart away so characteristic of the species in the wild state. But from this he very quickly recovered, and the tendency to be thus frightened grew less and less. The authors referred to also state that "they appeared to have some aversion to playing on a wheel, which is so favorite an amusement of the true squirrels." This does not at all agree with my observations; for though at first my chipmunk was apt to be startled when he found the revolver of his cage moving on his entering it, he soon got used to it, and delighted in it as much as any squirrel could—in fact, he used it by night and by day, manifesting an ability to control it which speaks much for the readiness with which such animals adapt themselves to new and difficult movements, and which shows how highly developed those parts of the brain must be which are concerned in the balancing and kindred functions. I may here correct another statement of the same authors. They maintain that squirrels do not lap fluids as the dog and cat. From repeated observations I know this to be an error, at least so far as the ground squirrel is concerned.

It has usually been assumed that squirrels, and indeed most rodents, feed wholly on vegetable food, and that in those instances in which the contrary has been observed there was evidence of a perverted or morbid appetite. Audubon and Bachmann, however, state that the flying squirrel (*Pteromys volucella*, Des.) has been caught in traps baited with meat. A number of writers,* especially within the past few years, have drawn attention to flesh-eating habits in several rodents, mostly under peculiar circumstances. Some interesting questions arise in this connection: 1. In how far is any rodent carnivorous, when abundance of all the different kinds of vegetable food that the animal uses is at hand? 2. What is the relation between confinement and altered appetites? 3. In how far are such altered appetites evidence of morbid or perverted conditions, and in how far simply the expression of physiological needs? The whole subject, I am inclined to think, might be placed on a broad and sound physiological foundation; but, before that can be done, many accurate observations are required, and possibly also many series of experiments. If we may judge by the common house rat, rodents possess unusual plasticity as to feeding and other habits, and not less as regards their mental life. I found that my chipmunk would take a great variety of foods, though the experiment of feeding with meat was not tried. He drank milk greedily.

There is one peculiar habit, interesting from a physiological point of view, to be observed in squirrels in confinement. A writer in "Nature" (vol. x) says, "I have noticed that whenever it [the squirrel] cleans itself, after licking, it sneezes violently three or four times into its fore-paws, then rubs them thus damped over its fur." And this writer raises the question as to whether this habit, which he believes voluntary, was confined to squirrels. He does not mention what sort of a squirrel his own was; but I have noticed this behavior as of most frequent occurrence in my caged chipmunk. It seems to me, on the whole, most natural to consider it a voluntary act of the same character, and possibly for a similar purpose, as cleaning the throat in the human subject, or perhaps even blowing the nose. And I am the more inclined to believe that it is voluntary, from the account given of the flying squirrel, as observed by Prof. G. H. Perkins and recorded in "The American Naturalist" (vol. vii). This writer states that on one occasion his squirrel lapped some ink, but shortly afterward manifested disgust and indulged in violent sneezings. Under these circumstances it is difficult to understand, by anything in our own experience, how the act could have been reflex.

Speaking of the relative intelligence of squirrels, this writer says, "I am inclined to believe that the flying squirrel does not possess as much intelligence as the gray or red or some other species." From the entire account of the flying squirrel given by Prof. Perkins, I should suppose that the intelligence of this species and that of the ground squirrel are about on a par—the explanation of which will be considered later.

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* "Science," vol. viii; "Canadian Naturalist," vol. iii.

A question of much interest to the naturalist and psychologist, it seems to me, is the following, viz., to what extent the intelligence of animals that hibernate has been modified by this process, and in what directions. With regard to hibernation, so far as the squirrels are concerned, there seems to be great dearth of accurate observations; in fact, the same remark applies to the whole subject of hibernation, one of the most interesting in the whole realm of physiology. A number of observations are to be found scattered through the literature, but they are fatally lacking, in most cases, in precision of observation and accurate record of dates. From a short but valuable paper on "The American Chipmunk," in "The Popular Science Monthly" (vol. vii), by Dr. C. Abbott, we are led to believe that the ground squirrel spends some time in his burrow before hibernation begins, and that the food laid up is consumed in part before the winter torpor sets in, and more especially in the spring before a fresh supply is obtained in the usual way. Concerning the winter habits of other species, I have been able to learn nothing from any quarter that definitely settles the question as to whether they hibernate or not. Audubon and Bachmann (*loc. cit.*) state that as much as one bushel and a half of nuts has been found in a single hollow tree occupied by a chickaree or red squirrel. They also state that this species may have several hoards. From different remarks dropped by these writers, from what I have myself observed, and from the statements of Dr. R. Bell, I am inclined to the belief that the red squirrel and some other species do not regularly hibernate the whole winter through. But whether they hibernate at all, in the true sense of that term; whether they have short periods of hibernation, followed by intervals of consciousness, during which they feed; whether they remain in a condition of partial torpor, with slowing of all the vital processes, and yet not in absolute insensibility and with cessation of respiration, etc.—all these questions seem to be as yet wholly undecided.

It has long been known that many cold-blooded animals hibernate and, under altered conditions, æstivate; it is further believed that among warm-blooded animals, besides bats, many rodents and some allied animals hibernate. But, when the matter is looked into carefully, it is found that the term "hibernation" has been used in a loose and very plastic sense by different authors. It is highly desirable, therefore, that writers should state exactly to what extent the animal they describe as "torpid," "hibernating," or "in winter-sleep," deviates functionally from the normal; also, that the exact time of the observations be recorded. There is a certain amount of evidence that even birds, representing the highest type of activity, may possibly hibernate; and that many animals, not usually thus affected, may become so under exceptional circumstances—indeed, that man himself, owing to peculiar states of the nervous system, may pass into a condition ("trance") having much in common with the hibernation of lower animals. I think it is very probable that, when the matter has been fully investigated, all degrees of cessation of functional activity will be found represented, from the normal daily sleep of man and other animals, to the lowest degree of activity consistent with the actual maintenance of life. The flying squirrel is nocturnal in habits and exceedingly active, even in confinement, as Prof. Perkins (*loc. cit.*) has shown; but during the daytime it seems not to be correspondingly quick—in a condition, in fact, resembling somewhat that of a hibernating animal. The "diurnal hibernation" of the bat is not to be forgotten. I noticed that my chipmunk invariably, after feeding, tucked his head down and assumed a more or less ball-like form highly suggestive of a tendency to hibernation.

There are many questions that arise in connection with this subject, one of which bears directly on the subject of comparative psychology: How and to what extent is the intelligence of animals influenced by hibernation? It may be considered pretty clear that both the ground squirrel and the flying squirrel hibernate, and these are certainly among the lowest—perhaps are actually the lowest—in intelligence of the whole tribe. We know that struggle among higher animals develops mental adaptation and other forms of intelligence, and it is rational to suppose that those species of squirrels that do not hibernate throughout the winter, but endeavor to prevail over their surroundings, as well as to adapt themselves to them, should be more intelligent than those spending a large portion of each year in inactivity.

My chipmunk, during its captivity, under certain circumstances, kept to his original habits—e. g., when a single nut was given him he would eat it immediately, but if several were presented at once he would hide them one by one in a corner of his cage, or, if sufficiently small, pack them away in his cheek-pouches. He did the same with cereal grains. When cotton wool or weblike material was placed in the cage, he manipulated it a good deal, but finally made a bed of it, in which he buried himself out of sight.

Within the last ten years attention has been called to "singing" in certain rodents, especially mice; but from numerous references in the literature it appears that "singing," or something analogous to it, has been noticed in a large number of rodents.* The well-known note of the chipmunk, from which it has derived its name, is the only one I have heard from it. After studying a colony of red squirrels for some weeks last summer, I came to the conclusion that they have a capacity of vocal expression much greater than is commonly believed. Their usual "barking," or trilling, seems to be the commonest, the most instinctive, and not largely expressive of anything beyond general satisfaction; but I found that, under excitement, there were many other tones, associated with great complexity of emotion, which I am not prepared to analyze, but which there can be little doubt the creatures themselves employ as a means of intercommunication. Under marked excitement, as the result of repeated interferences, I have heard a red squirrel so mingle tones of a musical kind that a stranger, arriving on the spot, would certainly have been deluded into the belief that he was listening to some bird, or rather to an excited pair of birds. The musical character of this combination, together with its continuity and complexity, would perhaps justify the designation "song." One of the writers on musical mice refers to their singing but little in certain instances, except when excited, which is a point of analogy with the chickaree.

It would appear, therefore, that it is likely that, throughout the order *Rodentia*, a genuine musical appreciation and executive capacity exists, and in some instances in a very high degree; and that apart from this there is also considerable ability displayed in the expression of states of emotion, at least, by vocal forms. Manifestly, the degree to which animals can express their psychic states—and especially in vocal forms—is a matter of the greatest importance, and I have already elsewhere ("Popular Science Monthly," March, 1887) expressed my conviction that animals have a power of communicating with each other, altogether beyond what has been generally surmised. The subject is beset with great difficulties, and calls for the closest observations.

The reviewer, in "The Academy," of Dr. Oliver Lodge's "Modern Ideas of Electricity" emphasizes the promise implied in the present state of scientific research and mathematical investigation that some great step forward is about to be made. "It is because the scientific world," he says, "knows itself to be on the verge of discoveries as to the nature of the ether, more far reaching possibly than the discovery of the mode of gravitation, that it lives in a state of suppressed excitement, which hinders it sometimes from further progress or from recognition of the relative importance of recent work"; and he hints that the century which produced Darwin is now ripe for almost a greater genius than he. A similar tone is sounded in Prof. Lodge's book.

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* See especially "Nature," vol. xv, "Popular Science Monthly," vol. l, and "The American Naturalist."

SKETCH OF DAVID RITTENHOUSE.

"AS a citizen of Pennsylvania," says William Barton, in the preface to his "Memoirs of the Life of David Rittenhouse"; "as an inestimable public and private character; as a distinguished son of science, of great probity and extensive usefulness in society—in all these points of view, the history of Dr. Rittenhouse may be contemplated as holding a relationship with almost every object connected with science and art in his day that could in any way contribute to the well-being of mankind in general and his native country in particular." He, in fact, acquired a fame in the period of the infancy of American science, the nature and extent of which can hardly be realized in this day; and his gifts, then regarded as extraordinary, were always freely placed at the service of the public.

DAVID RITTENHOUSE was born in Roxborough Township, near Germantown, Pa., April 8, 1732, and died in Philadelphia, June 26, 1796. He was descended from a family of paper-makers residing at Arnheim, Guelderland. His great-grandfather, William Rittenhouse, a Mennonite preacher, came from Holland with his family in 1687–'88; was the first Mennonite minister in Pennsylvania; and established the first paper-mill in this country, at the spot where David was born.

David was early put to work on the farm, and was plowing at fourteen years of age. An uncle dying had left him a chest of tools and a few books on arithmetic and geometry, with some manuscript mathematical calculations. These furnished palatable food to his mind, and his biographers tell of his having covered the handle of his plow and the fences around the field with his workings of the problems which they set before him. As the uncle mentioned above was his mother's brother, it is inferred that he inherited his genius from his mother's side. His mechanical talent was shown in his construction of a complete water-wheel in miniature when eight years old, a wooden clock when seventeen, and a clock with metallic works at a later age. His father was not disposed at first to favor the youth's tastes, but eventually he furnished him with money enough to buy a set of clock-making tools; and David built a workshop at Norriton, whither the family had removed, where he carried on the clock-making business for several years. He at the same time pursued his studies so diligently that he impaired his constitution, and contracted a pain that afflicted him all his life. Astronomy appeared to be his favorite study; and he was interested in optics and mechanical science. He discovered himself, independently, the method of fluxions, of which, in his imperfect knowledge of what Newton and Leibnitz had done, he believed himself to be the originator; and mastered the English translation by Motte of Newton's "Principia."

The acquaintance which he formed in 1751 with Thomas Barton, who afterward married his sister, had an important influence in shaping his career. Rittenhouse, according to William Barton, "possessed a sublime native genius; which, however, was yet but very imperfectly cultivated for want of indispensable means of extending the bounds of natural knowledge." Barton had enjoyed these means, and had acquired the reputation of being a man of learning. He found Rittenhouse's society profitable, and Rittenhouse found his equally so. Barton aided Rittenhouse greatly by helping him to the books he needed. Partly through his instrumentality a circulating library was established at Norriton; and he bought books for Rittenhouse when he went to Europe.

Mr. Rittenhouse was called upon in 1763 to determine the initial of the boundary-line between Pennsylvania and Maryland, his particular duty being defined to be to ascertain and fix the "circle to be drawn at twelve miles' distance from New Castle, northward and westward, with the beginning of the fortieth degree of north latitude," etc. The work was an arduous one, and involved going through a number of tedious and intricate calculations. It was performed in a satisfactory manner, for which acknowledgment was made in the shape of extra compensation, and with instruments to a large extent of Rittenhouse's own making; and his observations were accepted without change by the official astronomers, Mason and Dixon, when they took charge of the work. He was afterward appointed to a similar work in 1769, by the commission to settle the boundary between New York and Pennsylvania. Among his scientific studies at this period were the investigation of variations in the oscillations of the pendulum under changes of temperature, with the device of a plan for compensation, and the construction of what he called a metalline thermometer. This instrument was so made—on the principle of the expansion and contraction of metals under variations of temperature—that the degrees of heat and cold were indicated by the movements of an index moving along a graduated semicircle. It was adapted, in form and size, to be carried in the pocket. He discussed the compressibility of water in the light of an experiment that had been reported to the Royal Society, and observed, in a letter to Mr. Barton, that, although the experiment did not please him, he did not doubt the fact; for, "if the particles of water were in actual contact, it would be difficult to conceive how any body could much exceed it in specific gravity; yet we find that gold does, more than eighteen times." We find him also at this time (1767) indulging in some amusing speculations on the possibility of a man's moving the world.

Some one having published the result of calculations he had made respecting the fulfillment of Archimedes's famous *dictum* on the subject, Mr. Rittenhouse gave the result of his own computations, which was that "the force wherewith a man acts when he lifts a weight of two hundred pounds, if applied without intermission for the space of one hundred and five years, is sufficient, without any machinery, to move the earth one inch in that time; and it must, from the velocity received by that force alone, continue forever after to move at the rate of one inch in fifty years." The first calculator had computed that twenty-seven billions of years would be required to accomplish the movement.

Mr. Rittenhouse's reputation as an astronomer became conspicuous, and his name, according to Mr. Barton, acquired a celebrity even in the Old World, "of which his early but now much-increased fame in his native country was a sure presage." A great bound was given to his fame by his construction of an orrery, or apparatus for illustrating the planetary motions, and by the conspicuous part which he took in the observations of the transit of Venus of 1769.

The design of the orrery is indicated in the correspondence with Mr. Barton in 1767, in the course of which Mr. Rittenhouse says: "I did not design a machine which should give the ignorant in astronomy a just view of the solar system; but would rather astonish the skillful and curious examiner by a most accurate correspondence between the situations and motions of our little representatives of the heavenly bodies and the situations and motions of those bodies themselves. I would have my orrery really useful by making it capable of informing us truly of astronomical phenomena for any particular point of time, which I do not find that any orrery yet made can do."

This instrument was bought before it was finished for Princeton College. The trustees of the College of Philadelphia had also been bargaining for it, and were disappointed over the turn the affair had taken. Mr. Rittenhouse had made a saving clause in his bargain in favor of the College of Philadelphia, in agreement with which he began another orrery for that institution. "This," he said, "I am not sorry for, since the making of the second will be but an amusement compared with the first; and who knows but that the rest of the colonies may catch the contagion?" The sum of two hundred pounds was obtained toward paying for the instrument by means of lectures on astronomy delivered by Rittenhouse's friend, the Rev. Dr. Smith, Provost of the College of Philadelphia, concerning which the Rev. Dr. Peters wrote, "The doctor in his introductory lecture was honored with the principal men of all denominations, who swallowed every word he said with the pleasure that attends the eating of the choicest viands, and in the close, when he came to mention the orrery, he over-excelled his very self." The members of the Assembly of Pennsylvania took a view of the orrery, and, "being of the opinion that it greatly exceeds all others hitherto constructed, in demonstrating the true Situations of the celestial Bodies, their Magnitudes, Motions, Distances, Periods, Eclipses, and Order, upon the principles of the Newtonian System," voted the constructor three hundred pounds in consideration of his mathematical genius and mechanical abilities, and appointed a committee to agree with him for a new orrery for the use of the public. This purpose was not carried out. Mr. Rittenhouse became engaged in public enterprises, which occupied his time till the beginning of the Revolution, when all other interests were suspended.

The praises which were bestowed upon Mr. Rittenhouse for his orrery were extravagant, and seem now even absurd; but nothing, perhaps, can more clearly illustrate the infantine condition of American science at the time.

Mr. Barton, by way of emphasizing the assertion that the skill and accuracy he displayed in the construction of his mathematical and astronomical instruments were not surpassed by similar works of the most celebrated British mathematicians, remarks that "his profoundness in astronomical science and his wonderful ingenuity, manifested in the construction of his orrery, leave him without a rival in the twofold character of an astronomer and mechanic." Dr. Jedediah Morse, in his "Geography" (1789), noticing some of the more prominent productions of scientific ingenuity and skill in America, observed that "every combination of machinery may be expected from a country, a native son of which, reaching this inestimable object in its highest point, has epitomized the motions of the spheres that roll throughout the universe." Mr. Thomas Penn, of London, was surprised that the instrument could have been executed in Pennsylvania. Joel Barlow wrote, in the "Vision of Columbus":

> See the sage Rittenhouse, with ardent eye,
> Lift the long tube and pierce the starry sky;
> Clear in his view the circling systems roll,
> And broader splendors gild the central pole;
> He marks what laws th' eccentric wand'rers bind,
> Copies Creation in his forming mind,
> And bids beneath his hand in semblance rise,
> With mimic orbs, the labors of the skies.

Thomas Jefferson, the sober statesman, Mr. Rittenhouse's successor as President of the American Philosophical Society, wrote, in his "Notes on Virginia," in refutation of the Abbé Reynal's assertion that America had "not produced one able mathematician, one man of genius in a single art or science": "We have supposed Mr. Rittenhouse second to no astronomer living; that in genius he must be the first, because he is self-taught. As an artist he has exhibited as great a proof of mechanical genius as the world has ever produced. He has not, indeed, made a world; but he has by imitation approached nearer its Maker than any man who has lived from the creation to this day."

A committee of thirteen persons was appointed by the American Philosophical Society early in 1769 to view the transit of Venus, which was to occur on the 3d of June—a phenomenon which had been scientifically observed only twice before. This committee was divided into three, for observation at three stations—Philadelphia, Mr. Rittenhouse's home at Norriton, and the lighthouse near Cape Henlopen. Three other observers were associated with Mr. Rittenhouse at Norriton. An observatory was furnished, and the preparations and calculations preliminary to taking the observations were made by Mr. Rittenhouse. Some instruments were bought for the other stations. For Norriton a reflecting telescope was furnished by Mr. Maskelyne, Astronomer Royal at Greenwich—afterward given to the Philadelphia College—an astronomical quadrant by the Earl of Stirling, of East Jersey; and an equal-altitude instrument, a transit telescope, and a timepiece were made by Mr. Rittenhouse. The results of the observations were communicated to the American Philosophical Society, and a report of them was furnished to Mr. Maskelyne, who declared that they seemed excellent and complete, and did honor to the gentlemen who made them and to those who promoted the undertaking. The whole affair, in fact, gave the observers great credit abroad, and was regarded as promising well for the future of American science. The importance of the observation may be judged from the fact that it furnished one of the elements for verifying the great astronomical unit—the earth's distance from the sun.

On the 9th of November following this observation a transit of Mercury—the fourth ever witnessed—was observed at Norriton by Mr. Rittenhouse and his fellow-astronomers, and a report on the subject was filed with the Philosophical Society. Shortly after this the difference of the meridians of Norriton and Philadelphia was determined by a committee, of which Mr. Rittenhouse was one, at the request of Mr. Maskelyne, who wished to connect the observations of the longitude of Norriton with those made by Messrs. Mason and Dixon in the course of measuring the degree of latitude.

About this time a scheme was started by Dr. Smith to induce Mr. Rittenhouse to remove to Philadelphia. Recommending him for appointment as a trustee of the Loan Office, then before the Assembly, Mr. Smith represented to the Speaker that he "ought to be encouraged to come to town, to take a lead in a manufacture, optical and mathematical, which never had been attempted in America, and drew thousands of pounds to England for instruments, often ill-finished; and it would redound to the honor of Philadelphia to take a lead in this, and of the Assembly to encourage it." The proposition was received enthusiastically, and the whole house rose to vote for Mr. Rittenhouse, one of the members exclaiming, "Our name is legion for this vote." The Assembly adjourned, however, without passing the bill, although Mr. Rittenhouse was afterward appointed to the position for which he was named in it. He removed to Philadelphia, on his own account, in the fall of 1770. The next scientific investigation in which he appears to have been engaged was the observation of the comet of 1770, of which he calculated the elements, and communicated the results to the American Philosophical Society. We afterward find him, with several other gentlemen, making experiments on the electric eel for the purpose of ascertaining the origin of the shock which the animal emits on being touched.

From this time on, Rittenhouse was to a considerable extent engaged in works in the service of the public, to some of which he was called in consequence of his scientific ability and mechanical skill, to others commended by his character as a citizen and his integrity. He was given charge of the State-House clock; appointed to survey the lands between the Susquehanna and Delaware Rivers; to superintend the improvement of the Schuylkill; and to determine the northwestern extremity of the boundary between New York and Pennsylvania.

In 1775 the American Philosophical Society presented to the Pennsylvania Assembly a plan for the erection of an observatory under State control, with Mr. Rittenhouse as "public astronomical observer"; describing him as "a gentleman whose abilities, speculative as well as practical, would do honor to any country. . . . Under his auspices the work could now be undertaken with the greatest advantages; and others may be bred up by him, to prosecute it in future times; but, if the present opportunity is neglected, perhaps whole centuries may not afford another. To rescue such a man from the drudgery of manual labor, and give him an occasion of indulging the bent of his genius with advantage to his country, is an honor which crowned heads might glory in; but it is an honor also, which it is hoped, in the case of a native, Pennsylvania would not yield to the greatest prince or people on earth." The Revolution came on, and the scheme was not carried out.

In view of that crisis, Mr. Rittenhouse was commissioned to prepare molds and have iron clock-weights cast, to be exchanged with the people for their leaden ones; as engineer to the Committee of Safety, to arrange for casting cannon; to view a site for the erection of a Continental powder-mill; to conduct experiments for rifling cannon and musket balls; to devise a method of fastening a chain for the protection of the river; to superintend the manufacture of saltpeter, and to locate a magazine for military stores. He was a member of the Committee of Safety in April, its vice-president in August, and its presiding officer in November, 1776. In 1776 he was a member of the Assembly from Philadelphia, and a member of the first Constitutional Convention of Pennsylvania; a member of the Board of War; and one of the Council of Safety, which had absolute powers. He was the first State Treasurer of Pennsylvania, from 1777 to 1789, when he declined to serve any longer. He was the first Director of the United States Mint, serving for three years from 1792; and he was called upon on several occasions to serve on commissions for the adjustment of boundaries. In connection with these public employments we find a curious letter from Mr. Jefferson to Mr. Rittenhouse, written in 1778, protesting against his wasting his abilities on affairs of state. "I am satisfied," he says, "that there is an order of geniuses above that obligation [to conduct government], and therefore exempt from it. No one can conceive that Nature ever intended to throw away a Newton upon the occupations of a crown. It would have been a prodigality for which even the conduct of Providence might have been arraigned, had he been by birth annexed to what was so far below him. . . . I doubt not there are in your country many persons equal to the task of conducting government; but you should consider that the world has but one Rittenhouse, and that it never had one before."

Mr. Rittenhouse was Professor of Astronomy in the University of Pennsylvania from 1779 till 1782, and was a trustee of the institution, continuing in that office after its reorganization in 1791. He was made one of the secretaries of the American Philosophical Society in 1771; became its vice-president in 1786; and succeeded Benjamin Franklin as president, on his death in 1790. He was elected a Fellow of the American Academy of Arts and Sciences in 1782, and an Honorary Fellow of the Royal Society in 1795. He received degrees from the College of Philadelphia, William and Mary College, and Princeton College.

He was tall and slender, quick in gait, had a countenance "indicative of intelligence, complacency, and goodness," and a disposition and manners that secured him friends and kept them. He bore testimony against the slave trade, and sympathized with the original motives of the French Revolution to such an extent that he assisted in the organization of the Democratic Society, and was made its president—but this was before the excesses of the Revolution were committed. While he might be called self-educated, he was not, as Mr. Barton shows, wholly without assistance in pursuing his studies, although some writers had mistakenly affirmed this, but that assistance was small. Dr. Rush assumed, in the eulogy he pronounced upon him, that the eminence he attained was to be ascribed "chiefly to his having escaped the pernicious influence of monkish learning upon his mind in early life"; otherwise, "instead of revolving through life in a planetary orbit," he might have spent his time "in composing syllogisms, or in measuring the feet of Greek and Latin poetry." He understood the German and Low Dutch languages, acquired a reading knowledge of French, and "overcame in a great degree the difficulties of the Latin tongue." He was a firm believer in the Christian religion, though he was not attached to any church. That speculative disquisitions were of little interest to him is shown, perhaps, as much as by anything, by his remark concerning a conversation with a clerical gentleman, that it was "not, perhaps, greatly to the satisfaction of either of us; for he appears to be a mystical philosopher, and I, you know, care not a farthing for anything but sober certainty in philosophy." He published but little, because, as his biographer believes, he was too busy with work to give his time to the composition of formal papers. The list of his contributions to the American Philosophical Society includes twenty-two titles of papers relating to his orrery; the transits of Venus and Mercury; the comet of 1770; a method of deducing the true time of the sun's passing the meridian; the difference of longitude between the observations of Norriton and Philadelphia; an explanation of an optical deception; experiments on magnetism; a remarkable meteor seen in 1779; a comet observed in 1784; a new method of placing the meridian mark; an optical problem; astronomical observations (on the Georgium Sidus and a transit of Mercury); an account of several houses struck with lightning; another account of the effects of a stroke of lightning; several astronomical observations described in a single paper; a mathematical problem; a comet observed in 1793; the improvement of time-keepers; the expansion of wood by heat; a problem in logarithms; and the mode of determining the true place of a planet in an elliptical orbit—his last paper, read February 5, 1796. To these is added his oration on "Astronomy," delivered before the American Philosophical Society, on the 24th of February, 1775, and inscribed "To the delegates of the thirteen United Colonies." In this oration, three years before the announcement of Mayer's discovery of the proper motion of certain stars, and six years before Herschel's discovery of Uranus, the author put forth the suggestion, which has since proved a presage, that the fixed stars, and particularly the milky way, would afford fruitful fields of observation

CORRESPONDENCE.

MORAL INSTRUCTION IN OUR PUBLIC SCHOOLS.

Editor Popular Science Monthly:

IN "The Popular Science Monthly" for January I read with much interest, but not surprise, an article by Benjamin Reece, on "Public Schools as affecting Crime and Vice." The author very clearly shows that our school system is not elevating the moral standard of the rising generation, as had been so sanguinely expected, but rather, that as the minds of the masses are increased in knowledge, there is an equal if not more rapid increase of vice and crime. But the root of the evil is not in the system of public instruction, for, as a general rule, no teacher is given a school who does not bear an exceptionally good moral character, and a majority of them are members of good standing in the various churches. With this guarantee for the moral training of the pupils by precept and example on the part of the teachers, it seems to me that all is being done in that line that can be done. Furthermore, the Sunday school, where moral training is especially attended to, is now considered an indispensable adjunct to every church; yet, with all this, vice and crime are on the ascending scale, and in a most astonishing degree.

It is a mistaken notion that simply to educate a people is to improve them morally; for a man can possess the most exalted moral qualities without the least intellectual culture, and *vice versa*. Now that our ethical hopes in public-school education are not fulfilled, what shall be further done to lessen this dark cloud of vice and crime? My answer is, we must combine other lessons with our present system of moral teachings, and these other lessons must be ethical object-lessons. Man, to a very large degree, is an imitative creature, and especially so in childhood. By constant imitation of what he sees others do, habits are formed, and, once formed at that early period, be they good or bad, are rarely, if ever, entirely suppressed in after-years. All the ethical subject-lessons may be given him that is possible; but if there be object-lessons that go counter to them, these invariably take the deeper root, and soon nullify or supplant the former.

With these truths before us, is it not the imperative duty of all—all who wish for good government, safety of person and property, and the advancement of the race—to become bright and living ethical object-lessons to the rising generation? Nor is this all that is to be done; we should discountenance and remove all who are not ethical object-lessons worthy of study. Man's imitative propensity is called forth principally by those whom he thinks are his superiors. Consequently all those in high places of all kinds who are pernicious object-lessons should be the first to be removed; for, if the source be putrid, the onflowing stream becomes foul also. The author, in the article referred to, very truly tells us that the fall of the Roman Empire was "an effect of a moral ruin." Now, all readers of Roman history know that the germ of this "moral ruin" had its birth in the topmost strata of Roman society; and the masses, with ready imitativeness, became rotten to the core. The sad *finale* of that wonderful empire we all know.

Is Roman history now preparing to repeat itself in these United States? The indications all strongly point that way. Do we not see venality and corruption pervading, more or less, every branch of the Government? Even our halls of justice are frequently tainted with it, while the politicians and office-seekers, with scarcely an exception, are prostituting the elective franchise throughout the land by a venal use of the "almighty dollar." This bribe-money is brought to bear almost exclusively upon the needy poor—making their pockets heavier, but dwarfing their moral manhood. With this state of things, is it to be wondered at that vice and crime are rolling up in billows mountain-high? Is it to be wondered at that our public schools, our Sunday schools, and pulpits are impotent to check the approach of this "moral ruin"? Nor can it be checked until the wise and the good throughout the land determine to elevate to places of honor and trust only those who are calculated to make the best ethical object-lessons for the study of the rising generation. How many can we point to who now sit in high places that would make good object-lessons for the study of all our school children? Purify the fountain, and the stream will become likewise limpid and pure.

E. P. MEREDITH.

ATLEE'S STATION, HANOVER COUNTY, VA.,
January 27, 1890.

POLITICS AND FARM MORTGAGES.

Editor Popular Science Monthly:

SIR: It was a gloomy picture of the condition and prospects of agriculture in the United States which Mr. Joel Benton drew in his article entitled "The Decadence of Farming," in the November "Monthly." A similar view is presented by Judge Nott, in a series of articles published by the New York "Evening Post;" while recent reports of the State Commissioner of Agriculture of Vermont and of New Hampshire substantiate these accounts as regards those two States. Abandoned farms in the East and farm-mortgage foreclosures in the West, Mr. Benton tells us, are becoming distressingly common, and many farmers who still hold and work their lands are struggling along under increasing indebtedness, or at best obtain only rapidly diminishing returns.

Certain of our public men, however, deny that agriculture in the United States is suffering such a severe depression as these statements indicate. The Hon. Philetus Sawyer, Senator from Wisconsin, has said, according to the "Milwaukee Daily Journal," that he had never known of but one foreclosure of a farm mortgage in his section of the country, and the remark was used in debate in the Senate by his colleague, Hon. John C. Spooner. Our members of Congress might be expected to furnish reliable information. They are selected to make laws for the people, theoretically, because each one knows the condition and needs of his constituents, and how to provide for them. But the above assertion has been investigated by the "Journal," with the result of proving, either that a false statement had been willfully made by one of the Senators, and repeated by the other, or that both were ignorant of affairs in the State they represent that any observing man must be aware of. Foreclosures have to be advertised in the local papers, and, out of forty of the "Journal's" exchanges from within the State, foreclosure notices were found in fourteen. In these papers were thirty-two notices. The papers examined are not more than one eighth of those published in the State. The "Journal" also wrote for the records of foreclosures for the last ten years in most of the counties of eastern Wisconsin, as far north as the farming region extends. In reply, letters were received, mostly from county officials, which were published in the "Journal" of February 1st, and which showed that in nine counties of Wisconsin there have been seven hundred and eleven farm-mortgage foreclosures in ten years, involving $1,297,905.49. These counties contain about one sixth of the population of the State, and, allowing liberal margins, the "Journal" estimates that twenty-five hundred farm mortgages have been foreclosed in the whole State during the past ten years. Senator Sawyer resides at Oshkosh, in Winnebago County, which is not one of the nine counties above mentioned, but foreclosures occur in the Senator's immediate vicinity as well as in the rest of the State. The "Journal" quotes the "Oshkosh Times" as saying, "In the year 1888 ten mortgages were foreclosed on farms in Winnebago County, and in 1889 four more changed hands in the same way." And yet Politician Sawyer declared that he had never known of but one foreclosure in his section of the country. It is obviously unsafe to assume that what a politician don't know, therefore, does not exist.

Senator Sawyer's alleged ignorance reminds one of Sam Weller's behavior on the witness-stand in the great Pickwick trial, when his father had been guilty of disturbing the court. On that occasion the judge asked:

"Do you know who that was, sir?"

"I rayther suspect it was my father, my lord," replied Sam.

"Do you see him here now?" said the judge.

"No, I don't, my lord," replied Sam, staring right up into the lantern in the roof of the court.

Senator Sawyer must have been looking hard in some other direction when notices of foreclosures in his section were floating about. Politicians do not deal much in facts. Their stock in trade is mainly exaggerated assertions, off-hand denials, and buncombe, and they trust to their eloquence, their artful ways of putting things, or to the authority of their official positions to secure belief. When it suits their purposes to have the truth known, they bring it out with a grand flourish of figures; but when it seems to them more politic to keep the public in ignorance, they take refuge in general assertions. The true state of affairs in any given case can only be learned by searching out all the separate facts. Just as truly as eternal vigilance is the price of liberty, the price of truth is thorough investigation.

Very truly yours,

Frederick A. Fernald.

New York, *February* 22, 1890.

RIGIDITY OF THE SUSPENSION BRIDGE.

Editor Popular Science Monthly:

Sir: In the article on "The Evolution of the Modern Railway Bridge," by Prof. Jameson, he says (page 478) that "it" (namely, the cantilever bridge) "can be given great rigidity and stability, which are impossible in the suspension (bridge)," to which should have been added, "as usually built," because otherwise the statement would not be correct.

Prof. Jameson himself correctly states in another place (on page 475) that "a suspension bridge is nothing else than an arch bridge turned upside down." It follows that a suspension bridge can be built just as rigid as an erect arch bridge. But it is demonstrable that a suspension bridge can be made more rigid, particularly against lateral forces, than an erect arch. A suspension arch is in *stable* equilibrium; an erect arch is in *unstable* equilibrium, and requires lateral bracing, which the suspended arch does not require. Thus, if the steel arches of the St. Louis Railway Bridge were turned upside down, with the roadway suspended from them, and if the compression tubes were replaced by steel links, the suspended arches thus formed would have the same vertical rigidity as the existing compression arches, and it is obvious that the lateral bracing which is necessary for the tubes of the erect arch could be dispensed with for the links of the suspended arch. The question of anchorages is outside of the comparison.

The popular misconception as to suspension bridges is due to the many insufficiently stiffened structures of this kind. No other bridge system can be built so imperfectly stiffened, and yet be safe, as the suspension bridge. An erect arch bridge built in the same manner would fall of its own weight.

Another popular and fashionable conception, but a misconception all the same, is as to the merits of the cantilever bridge. Theoretically and practically, the cantilever of all bridge systems has the greatest deflections and oscillations under passing loads, *all other things being equal*, and therefore is the least rigid system. It has, however, its good uses otherwise. GUSTAV LINDENTHAL.

PITTSBURG, PA., *February* 2, 1890.

THE SALT PRODUCT OF KANSAS.

Editor Popular Science Monthly:

DEAR SIR: In your issue of January, 1890, page 430, under "Notes," it is said, "One hundred and fifty-five barrels of salt were manufactured in Kansas in 1888, and it is estimated that the output in 1889 will be not less than three times as large."

From the annual report of the Secretary of the State Board of Agriculture for 1888, it is learned that seven salt-works reporting produced 122,420 barrels. Of the seven, three reported to December 31st, and four to November 30th. One of the seven reporting began March 15th, three in October, and two in November.

From the same source for 1889, 547,224 barrels of salt were manufactured and 19,056 tons of salt not put in barrels. Seventeen companies reported in the latter year.

I have bought a copy of "The Popular Science Monthly" since its first publication, and I was loath to pass such an error unchallenged. Success to you and yours.

J. G. WOOD.

TOPEKA, KANSAS, *February* 11, 1890.

[The number intended was 155,000 barrels. The dropping out of the thousands in transcribing the item escaped notice. On the basis of that number, the output of Kansas salt in 1889 would be, according to Mr. Hay's estimate, not less than 465,000 barrels. We thank our correspondent for giving us the opportunity of correcting the error.—EDITOR.]

EDITOR'S TABLE.

POLITICAL ECONOMY.

AMONG the regularly constituted sciences that claim the attention of the world to-day, it can scarcely be said that political economy has an undisputed place. Fourteen years ago, in an article on the centenary of the "Wealth of Nations" (which fell in the same year as the centenary of our Declaration of Independence), the late Prof. Jevons acknowledged that there was then far less agreement among teachers of political economy, in regard to the fundamentals of their subject, than there had been fifty years earlier. He acknowledged, also, how little interest was taken in lectures on political economy at the universities, and how little weight was attached by practical men to propositions or principles put forth as the result of studies in that field. How does the matter stand now that fourteen years more have flown? Has the credit of the economists of the generation that has passed away—the Mills, the McCullochs, the Seniors, the Says—been in any degree rehabilitated? Scarcely. As time goes on, it becomes increasingly clear that the whole work of these writers was carried on too much in the region of abstractions, and was too little vivified by direct contact with facts. Bacon long ago remarked on the error of those who supposed in nature a greater simplicity than really exists; and this error was abundantly exemplified by the classical or "orthodox" economists. It was to certain minds, no doubt, a fascinating pursuit to seize upon two or three general principles, and by their help to interpret and methodize all the complex phenomena of economic production, distribution, and exchange; but the process was hazardous in the extreme, and much that passed for brilliant philosophizing fifty or even thirty years ago is now regarded as little better than obsolete sophistry. Two of the latest works that have fallen into our hands—Mr. Wordsworth Donisthorpe's "Individualism; a System of Politics," and Prof. Thorold Rogers's "Economic Interpretation of History"—illustrate this very strongly. "Practical men," says the former, "have long since ceased to attach any importance to the slipshod twaddle of those who pose as the theorists of the art of wealth-producing." The latter, referring, as it would seem, particularly to Mill, says: "The political economist of the later school has thoroughly carried out in his own person the economical law which he sees to be at the bottom of all industrial progress—that of obtaining the largest possible result at the least possible cost of labor. He has, therefore, rarely been at the trouble of verifying his conclusions by the evidence of facts. He has, therefore, constantly exalted into the domain of natural law what is, after all, and at the best, a very dubious tendency, and may be a perfectly baseless hypothesis. His conclusions have been rejected by workmen and flouted by statesmen."

We quote these passages not as fully indorsing them, but simply as showing to what extent the authority of a school that once was dominant is to-day called in question, if not discredited. At the same time, we fully believe that, before political economy can be a science in any satisfactory sense of the term, it has to be reconstructed and rewritten in the light of careful inductions from vast collections of facts. The basis of the "orthodox" economy was too narrow, while its method was too deductive and dogmatic. Mr. Mill was a man of a mind at once acute and candid; but he had not received the education that fitted him for the vast task which he assumed of reviewing the whole field of economics and enlarging its boundaries.
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this field than in any recognized department of natural science. What the effect upon social order and progress of a really well-constituted science of political economy will be it is not difficult to foresee. It will act as the great harmonizer of conflicting claims, and a most potent aid to the realization of justice in all human relations. And once more it will be proved that the only way to know things is to know them practically, and that the only way to build up a science is to bring the facts together, and *all* the facts.

EXAMPLE IN MORAL TEACHING.

OUR correspondent, who writes on "Moral Instruction in our Public Schools," in this number of the "Monthly," points out an influence that profoundly affects the education of American youth. What Mr. Meredith states in modern scientific language—that man is an imitative creature—had been learned generations ago from the experience of practical men, and applied to education in the terse maxim, "Example is better than precept." Who that has had the care of children does not know how readily they do what they have seen older children and grown people do, and how hard it is to make them remember what they are told to do! This should be a sufficient reason to make every person so order his daily life that it shall be an improving object-lesson to his own children and to the children who are to be the associates of his own. It should be a sufficient reason, also, as our correspondent points out, for elevating only men of high integrity to positions of trust and power. In a country where it is possible for any native-born boy to become the head of the nation, youthful ambition has free scope. In order to satisfy this desire, the means by which public officials have risen to power are copied, the traits of successful men are imitated, even the manners and habits of those whom the people honor are adopted by the young. Hence it is extremely important that these means and traits and habits should be worthy of imitation. A determined effort should be made to check the demoralizing influence at present exerted by American public life. If this is not done speedily, the evil will grow as slavery grew, till it finally challenges the nation to a life-and-death struggle whose outcome no one can foresee. The example set by the present generation will determine whether the children now growing up shall be arrayed on the side of virtue and honor, or shall swell the ranks of corruption and crime.

We emphatically dissent, however, from Mr. Meredith's proposition that all is being done in the public schools that can be done, in the line of moral instruction. There is probably not a city or town in the country where morality is a recognized subject of instruction in the common schools, standing on the same footing as spelling or geography. Our schools give only information that will serve business purposes or discipline the mind, and utterly neglect training in right conduct. Their aim is to turn out money-getters, rather than to produce good citizens. If our schools were to give as much attention to judicious instruction in ethics as they now devote to the teaching of arithmetic, for instance, we believe that they would come much nearer to exerting the beneficial influence that is claimed for them than they do at present.

AN UNFOUNDED STATEMENT.

THE "Chautauquan" is a magazine published for the benefit of what is known as the "Chautauqua Literary and Scientific Circle." It is religious in its general character. It contains "Sunday Readings" which are noted as "selected by Bishop Vincent." In one of these we lately read the following: "Some counselors, like Herbert Spencer, advise us to follow our own self-interest, without concern for others, with the assurance that all will be thus happier, because more independent." Now, why a statement like this, which is absolutely without foundation and entirely misleading, should be considered as particularly suitable for Sunday reading, we, who are not of the "Circle," can not in the least divine. It is given to the members of the Circle, however, as the utterance of a leading educator, Dr. Hill, President of the Baptist University of Rochester, and with the indorsement of Bishop Vincent, who, by selecting it, stamped it with his approval. The ordinary members of the Circle will, therefore, feel justified in accepting it without hesitation or reserve, and will form their opinion of Herbert Spencer accordingly. The wrong is done, not so much to Mr. Spencer, whose reputation is established in the world of philosophy and science, as to the members of the Circle, who are made to receive a false impression of his moral teaching. If Bishop Vincent is not too busy with work of more importance, we would earnestly invite him to do one of two things—either justify the above statement in regard to Mr. Spencer or withdraw it, and that in the same columns in which the statement appeared. We affirm most emphatically that it does entire injustice to Mr. Spencer's teaching.

LITERARY NOTICES.

Physiology of Bodily Exercise. By Fernand Lagrange, M. D. The International Scientific Series, Vol. LXVI. New York: D. Appleton & Co. Pp. 395. Price, $1.75.

In early times men depended upon the constant use of their physical strength to obtain the means of subsistence, and to protect themselves and their possessions against violence; during a later period, when a class had arisen whose subsistence was provided by serfs, even these were still required by custom to use their muscles in warlike exercises; at present a large and increasing portion of civilized men are engaged in occupations which do not demand bodily exertion, and much of the labor formerly done by human muscles is now performed by steam and electricity. The modern man has reveled for a time in bodily inactivity, but is now waking up to the fact that exercise is as essential to health and the enjoyment of life as sufficient food and sleep. But there are many who have not yet learned this lesson, and not all of those who are willing to take exercise have the right knowledge to secure for them its full benefits, or to protect them against its misuse. Knowledge of this sort it is the object of the present volume to supply. We do not know of any other book that explains so fully as this what goes on within the body when the muscles are used. The author first describes the process of muscular work, then explains the nature of fatigue, tells what changes in the body are produced by habituation to work, what the essential characters of the different exercises are, what results are effected by different kinds of exercise, and closes by pointing out the office of the brain in exercise. The slightest movement performed by the human machine, he says, brings into play the neighboring parts, and sometimes also more distant ones. The old soldier who said, "When I had my two legs, I used to give a splendid blow with my fist," spoke sound science. Hence an exercise may produce marked effects in a part of the body where we should not have dreamed of looking for them. The great organic functions of the body are not isolated from the work of the muscles. More blood is drawn to the working muscular masses, and this stimulus to the circulation causes the lungs to draw in a larger supply of air. It is commonly said that work produces heat in the body, but in reality the heat is the cause of the work, and is itself produced by combustion of the nutritive substances derived from our food, of the fat, and, when these are exhausted, of the bodily tissues. The waste products of this combustion clog the muscles and are one of the causes of fatigue. Breathlessness is caused by violent exercise, which suddenly increases the quantity of carbon dioxide in the blood, and makes a great demand on the lungs to eliminate the poison. The stiffness of fatigued muscles is due to other waste products, notably the urates. Overwork causes more of such products to be produced than can be excreted; hence they accumulate within the system, and their poisonous action often brings on a fever similar to typhoid. The organism is poisoned by its own products. Repose brings cessation of painful frictions of nerve-fibers and shocks of muscle-fibers, and allows time for the elimination of waste products and the repair of the tissues. The construction and action of the bodily organs become so modified by training that they can do more work without fatigue than before. Dr. Lagrange classifies exercises as those of strength, of speed, and of endurance. Before passing to the general effects of exercise, he tells what groups of muscles are brought into action in the common exercises. Exercise produces salutary effects, he says, alike in those who assimilate too little and in those who do not dissimilate enough. The enlargement of the chest cavity is one of the most beneficial results of exercise, and many suppose that it can be best secured by the use of the arms, but Dr. Lagrange argues that exercises of the legs are most effective in expanding the lungs, because the legs can do more work than the arms, and thus create a greater respiratory need. The author then points out how some popular exercises cause deformity, and names others which do not have this tendency. It has been found that brain-work, like muscular exertion, is attended by a greater flow of blood to the working organ, an increase of heat, more vigorous combustion, and hence increased formation of waste materials. Mental overwork, also, leads to feverish states, which must be attributed to the accumulation of products of combustion, as in the case of physical overwork. Now, while the muscles are the immediate agents in bodily movements, the exciting cause of the movements is the will. In executing a difficult feat much brain-work is demanded in order to co-ordinate the muscles employed, and, if the brain is already overworked, the author concludes, such an additional mental task is injurious. Hence, for persons suffering from mental overwork, exercises which can be performed automatically should be prescribed, rather than exercises of skill. The volume furnishes practical information which will enable the reader to so regulate the amount and kind of his exercise as to benefit and not injure himself. Its style is simple, and the reader is led along by such easy steps that the course of the exposition can be readily followed. This latest addition to the International Scientific Series ranks with the best of its companions in importance and general interest.

THE CONTINUOUS CREATION. AN APPLICATION OF THE EVOLUTIONARY PHILOSOPHY TO THE CHRISTIAN RELIGION. By MUYRON ADAMS. Boston and New York: Houghton, Mifflin & Co. Pp. 259. Price, $1.50.

THE author of this work, who is pastor of a Congregational church in Rochester, N. Y., believes that the "inevitable revolution which Matthew Arnold declares is befalling the religion in which we have been brought up, is part of that evolution by which God continues the higher processes of creation." He conceives the possibility of thinking under the principle of evolution and at the same time as a Christian believer, and believes that before long it will be found impossible to think clearly in any other way. The book is the outcome of a course of Sunday evening lectures which he delivered to his congregation on evolution and its relation to religion. A key to the central thought of the work may be found in a comparison, in the second chapter, between the former and more recent theories of creation. "According to the old story of creation, which was based upon no facts, but only upon a misinterpretation of revelation, God made man at one stroke, not as a sculptor makes a statue, not as an inventor makes a machine, but as the magician makes his prodigy. Accordingly, God is no constant and necessary factor of creation, but is a being who may be dispensed with, except for occasional irruptions into our region of space to perform wonders. Now, in place of such a conception, evolution offers a far nobler one; and produces an array of facts, ever increasing in bulk and significance, to substantiate it. The process of change which goes on generation after generation, and age upon age, is creation. The Creator does not act as a magician, suddenly, as by mere impulse, but as the steady, eternal energy, and ever according to that purpose which we begin to consider." Again, in the chapter on "The Idea of God": "When we are told that evolution abolishes God, or renders him superfluous, we see, on the contrary, that evolution can not proceed one step without God. The materialist may declare that evolution proceeds by material energy or force. The agnostic may say that we do not know and can not know. The theist identifies the universal Power and Intelligence, proceeding by universal laws, as the Being of whom men have had imperfect intuitions, of whom men have had inspirations." As to the bearing of evolution on religion, we are told: "There is a feeling that evolution is dangerous. The exaggeration of that feeling is that evolutionary philosophy comes as a whirlwind to destroy religion; on the contrary, it comes to restore and revive it. My friends, evolution will prove itself dangerous to the kind of religion which treats it in that way. The religion that seeks to stand on the ground of opposition to light, on the ground of resistance, will find itself more and more threatened and undermined by it." The evolution of the idea of immortality is also regarded as of the highest importance, as showing the consummation of the works of creation. Other special topics considered include the Bible as a record of religious gradual growth, "the problem of evil," the relations of evolution with Christianity and with special features and aspects of Christian faith, and its relations with social institutions and development. Finally, criticism, both higher and lower, and that of all shades and grades between, is declared really to have but the one purpose of coming at the abiding and the useful. The law of development being all-inclusive, "truth, sacred truth, must also have its course of development and progress. It can not long be contained in any statement or mass of statements. It increases by its own vitality and outgrows the most elaborate and finished form in which any age can put it. And, above all, religious truth is not stationary—a jewel cut and fashioned by skillful device; it is in the nature of seed, inclosing the elements of growth, else it is no vital truth. . . . The serious concern of all men ought to be to know the truth, and to commit themselves to it. Not to commit themselves to the uncertainties, but to the certainties. So far as they do that, they will have no fear of the thrashing process of criticism which comes at various periods, and has now come."

Epitome of the Synthetic Philosophy. By F. Howard Collins, with a Preface by Herbert Spencer. New York: D. Appleton & Co. Pp. 571. Price, $2.50.

We have here an eminently useful idea carried out in a very satisfactory manner. Mr. Collins has undertaken the by no means inconsiderable labor of going over the ten published volumes of Mr. Spencer's system of philosophy and summarizing them page by page. As he states in the "Compiler's Preface," "The object of this volume is to give in a condensed form the general principles of Mr. Herbert Spencer's philosophy as far as possible in his original words. In order to carry out this intention, each section (§) has been reduced, with but few exceptions, to one tenth; the five thousand and more pages of the original being thus represented by a little over five hundred. The 'Epitome' consequently represents 'The Synthetic Philosophy' as it would be seen through a diminishing glass; the original proportion holding between all its varied parts." Mr. Collins has aimed to present every salient point, to omit no essential link in the argument by which the celebrated exponent of the doctrine of Evolution deduces the whole course of history and the laws that govern all nature, animate and inanimate, from certain fundamental postulates of the most abstract or at least of the most general kind. The first thing that strikes us is the severity of the test to which Mr. Spencer's philosophy has thus been subjected. Stripping off all externals and non-essentials, Mr. Collins has laid bare the very framework of the system. He has reduced the Synthetic Philosophy to a series of almost naked propositions, the connection or lack of connection of each of which with those that precede and follow can be seen at a glance. Opinions will doubtless differ as to the degree of logical coherence thus brought to light; but we must declare, for our own part, that we are impressed anew, not only with the wonderful grasp of Mr. Spencer's mind, but with the philosophic unity of his thought. The apostle of Evolution has afforded us, in his successive volumes and in the successive chapters of each volume, one of the most magnificent examples of evolution. The success with which he has developed his system speaks powerfully for its essential conformity with the true order of nature.

It is hard to say whether Mr. Collins has rendered a greater service to those who are already familiar with Mr. Spencer's writings or to those who will first obtain some knowledge of them through his book. Certainly the former will thank him warmly for having placed within their reach a compend which will enable them at any moment to study to the greatest advantage the connection of the different parts of Mr. Spencer's system, and to refer at once to any portion which requires for its full comprehension that more complete elucidation which Mr. Spencer's own works supply. In the preface he has written for the present work Mr. Spencer says that he was somewhat surprised to find that it had been possible "to put so much into so small a space without sacrifice of intelligibility." We are not surprised at his surprise. The result must be attributed to Mr. Collins's skill; but it also testifies to the essential lucidity of the text on which Mr. Collins was working. With the utmost skill he could not have made pages intelligible that were involved in obscurity and self-contradiction. No one who is really interested in Mr. Spencer's writings will care to be without the present manual. Giving, as it does, the gist of every paragraph in the original volumes, it will in many cases render the consultation of those volumes unnecessary. What Mr. Spencer thinks is here, we might almost say, fully set forth. His own books give us in addition confirmatory reasonings and illustrations. Any one, therefore, who, without knowing anything of Spencer, becomes interested in Mr. Collins's epitome will probably seek the fountain-head whence so much of striking thought and compact argument has been derived.

Naturally, certain parts of the present epitome are more effective than others. The section on the Unknowable in Mr. Spencer's "First Principles" does not admit of much condensation, and here the epitome is too abstract for anything like general reading, though possessing in common with all the rest a high degree of usefulness for serious students of Spencer. The same remark applies to large portions of the "Psychology;" but in the biological and sociological portions Mr. Collins has given us a version of Spencer that is at once pithy, vigorous, and thoroughly interesting. We could quote scores of paragraphs that tell their tale with admirable condensation and point, and that make good reading for any day in the year. The effect, therefore, of the present work, we may hope, will be to popularize to some extent a system of thought which, abstract as it may seem, has been elaborated by its distinguished author in the most practical spirit possible and which can not become more widely known without conferring proportionate benefit upon society.

Special Physiology, including Nutrition, Innervation, and Reproduction. By John Gray M'Kendrick, M. D., LL. D., F. R. S., Professor of the Institutes of Medicine in the University of Glasgow, Fellow of the Royal College of Physicians of Edinburgh. London and New York: Macmillan & Co. 1889. 8vo. Pp. 803. Price, $6.

Dr. M'Kendrick states in his preface that it has been his "endeavor throughout this volume to lay before the reader the main facts of physiological science, and as far as possible to state these facts in terms of measurement. The time has gone past for vague generalities in the description of physiological phenomena, and physiology is year by year drawing nearer to her true position as a science, dealing as strictly with the phenomena and basis of organic life as physics deals with those of dead matter."

The book is divided into sections, subdivided into chapters. The sections deal, in order, with nutrition; food; digestion; absorption; the blood and its circulation; respiration; assimilation or nutrition; glycogenesis; excretion; the income and expenditure of the body; animal heat; the nervous system; the senses; the voice; animal locomotion; and reproduction. There are four hundred and eighty-five illustrations.

Dr. M'Kendrick's well-known scholarship is a guarantee that this book is a valuable one. But that such is the fact would be quite apparent from inspection, even were his name not placed on the title-page. It gives the latest results of physiological study with accuracy and exactness. Whether or not his expectations, quoted from the preface, are ever to be realized, he certainly has aided to advance the science of physiology in the direction of his ideal. While the difficulties in the way of quantitative estimates of physiological phenomena are sometimes very great, that is no reason for relaxing efforts to overcome them, since in the accomplishment of this lies the hope of perfecting the science.

We have little space for special criticisms, but we think the author would have done better to leave some things to psychology, which he includes in his work. For instance (page 658), he speaks of *pain* as "a third kind of sensation, unlike touch and temperature." Now, there is a long-standing controversy as to this point—whether pleasure and pain are distinct sensations or a quality of all sensations. Dr. M'Kendrick ought to have seen that this question could not be disposed of in a paragraph. Moreover, he should have recognized that it is clearly and peculiarly a psychological question. To include such a statement as he makes in a physiological work is certainly an error, whether he be right or wrong. And the assumption he makes is, besides, one which he would have great difficulty in substantiating. The likelihood is that pleasure and pain are not distinct forms of sensation, but qualities of all sensation whatsoever.

PROBLEMS IN AMERICAN SOCIETY. By JOSEPH H. CROOKER. Boston: George H. Ellis. Pp. 293. Price, $1.25.

SIX essays on moral and social problems of the time constitute this volume. The first is entitled "The Student in American Life," and its key-note is contained in the words "Americans are prone to ignore the vast practical importance of cultivated men." The second essay gives a sketch of the history of scientific charity, from the "Hamburg System" to the "Charity Organization" system of England and America, embodying many of the principles of this method of diminishing poverty. "The Root of the Temperance Problem" is the subject of the next paper. The author does not think attacking the saloon-keeper is the way to reach the root of drunkenness. On the contrary, "true temperance methods," he says, "are such as reach the reason, the conscience, and the will of each individual." There is an essay on "The Political Conscience," which in many men is a coarser article than
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betes are especially associated with the mental activity of town-dwellers. Their children are sickly, and if it were not for the constant inflow of new blood from the country, the towns would be depopulated in three or four generations. Dr. Richardson, in his introduction to the volume, says, "The divisions are excellent, the title of each division attractive, and the mode of progress from stage to stage artistic." He draws attention to certain "short, sharp sayings, each one in its proper place, and easily learned and not easily forgotten." As samples of these he quotes, "Flags and pavements produce no grass." "Brains are the finest raw material of a country." "To kill the weak and injure the middling is a long price for education." He calls it also an eminently suggestive book, which, if the author had lived, would doubtless have been expanded.

ON THE CREATION AND PHYSICAL STRUCTURE OF THE EARTH. By JOHN T. HARRISON. London and New York: Longmans, Green & Co. Pp. 189. Price, $2.50.

THE author offers this production as an essay toward a theory of the formation of the earth's crust. In his discussion he makes liberal use of passages in the writings of the leading geologists, which often reveal wide differences of opinion concerning the questions discussed. He also puts at the heads of several chapters, and scatters through his text, passages from the Bible, with which he evidently deems it essential that his views should conform. A striking case of this tendency to subordinate his opinions to the imagined geological teachings of the Bible is where he says that the earthquakes which now occur result from disturbance of the crust in one or other of the old lines of rupture, and asks, "Who can earnestly consider this condition of the earth and say that it may not be nearly ripe for another paroxysm?" He then quotes from Prof. Hitchcock to the effect that the earth contains within itself chemical energies sufficient to accomplish its own destruction, and adds, "We have the yet older and surer revelation that the earth shall reel to and fro like a drunken man, and, when enveloped in flames, all the works of man shall be burned up." This, in spite of the fact that the progressive cooling of the earth points to its end in frigidity.

A TEXT-BOOK OF ANIMAL PHYSIOLOGY, WITH INTRODUCTORY CHAPTERS ON GENERAL BIOLOGY AND A FULL TREATMENT OF REPRODUCTION. For Students of Human and Comparative (Veterinary) Medicine and of General Biology. By WESLEY MILLS, Professor of Physiology in McGill University and the Veterinary College, Montreal. New York: D. Appleton & Co. 1889. 8vo. Pp. 700.

THE plan of this important work is new. It adopts the comparative method, begins with general biology, treats of the cell as the unit, gives an account of unicellular vegetal organisms both on the morphological and the physiological side, then of unicellular animals, next of multicellular organisms, leading up to a consideration of the animal body, the animal kingdom and man's place therein. Following all this is a full exposition of the origin of life in general and of reproduction, very admirably presented. Then the chemical constitution of the animal body is taken up, the blood and the contractile tissues are examined, the graphic method is extensively applied to the study of muscle physiology, the circulatory system is explained, succeeded by an account of the digestive system. Excretion is next dealt with, then the metabolic or chemically transforming processes, while the nervous system and the senses form the concluding portions of the work.

The plan has obvious advantages. It is much better adapted to giving the learner a correct and comprehensive view of physiology than treatises in the usual form and order. Moreover, the work in question is admirably executed and has all the characteristics of a truly scientific production. It is certain that physiology must be hereafter studied with reference to general biological laws, and not by piecemeal methods. Then books like the present one will inevitably supersede the older text-books, presenting a less unified physiology. Dr. Mills's volume will help this progress. It may be safely recommended as one of the best treatises on the subject extant, and in respect to method we know of none more praiseworthy.

LA PISCICULTURE EN EAUX DOUCES (Fish Culture in Fresh Waters). By A. GOBIN. Paris: J. B. Baillière et Fils. Pp. 360.

M. GOBIN has given us a handy and useful book, comprehensive and practical. The subject has been introduced into the agricultural and national schools of France, and the art has become there, according to the author, not only a regular branch of industry, but also the fashion. It is recommended as being equally well adapted to women with the care of poultry, bees, and silk-worms. "As a recreation, it interests the mind and the eyes; and it has been well tested as an economical resource. As a regular pursuit, it has been taken up and then dropped several times; in the present effort that is making to establish it on a systematic basis, the United States is acknowledged to be in advance of any of the European countries which are named. Of its importance, the author well says that, in a period of civilization like that which we have reached, every waterfall, however slight it may be, should and can be utilized as a motor force, and every stream and water surface should be made to support the maximum of aquatic inhabitants best suited to purposes of food. To obtain this condition, nothing has to be created. All that is necessary is "to study and adopt what has been done in England, Switzerland, some places in Germany, and especially in the United States." In the several chapters and sections of the book are considered the properties of fresh water, the different kinds of fish, natural and artificial breeding and feeding, the construction and management of fish-ponds, the management of lakes and methods of dealing with running waters, migratory and "sedentary" fish, crustaceans, lagoon fish, and sea fish. The whole is abundantly and satisfactorily illustrated, and a classified list of the fresh-water fishes of France is added.

A paper that will have value for manufacturers of iron and steel is that on *The Construction of Cupolas for the Melting of Pig-Iron*, by *M. A. Goury, Jr.*, translated by *W. F. Durfee*, which appeared in the "Journal of the Franklin Institute" for January, 1889. It presents, in one comprehensive view, most of the experiments that have been tried in many lands, with a hope of improving the working of cupolas; and the translator believes that, if its conclusions are intelligently followed by users of cupolas, very large economies of fuel will result. Among the experiments whose history is given
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The following five books and pamphlets are issued by the Woman's Temperance Publication Association: *The Year's Bright Chain* (price, 50 cents) consists of twelve pages of quotations from the writings of *Frances E. Willard*, alternating with full-page pictures representing the months. Each picture is accompanied by a couple of stanzas of verse telling the wish the month grants to a boy and to a girl. A finely engraved steel portrait of Miss Willard forms the frontispiece. The artistic and mechanical quality of the book can not fail to delight her young admirers. *Frances Raymond's Investment*, by Mrs. *S. M. I. Henry* (price, 50 cents), is the story of a woman's complaint against the State for the loss, due to the licensed saloon, of what her boy had cost her. *The Unanswered Prayer; or, Why do so many Children of the Church go to Ruin?* also by Mrs. *Henry* (price, 50 cents) consists of several chapters of counsel to mothers in regard to saving their children from the evils and dangers that beset them. *Songs of the Young Woman's Christian Temperance Union*, by *Anna A. Gordon* (price, 25 cents), consists of ninety-five pages of words and music, suitable for temperance meetings. *Crusader Programs* (price, 25 cents) is a collection of exercises, consisting of recitations, dialogues, etc., interspersed with songs, and designed for the Loyal Temperance Legion, Sunday schools, etc., and adapted to Arbor-day, Easter, Decoration-day, and other occasions.

A new review, called *The Arena*, has been started in Boston, under the editorship of *B. O. Flower* (The Arena Publishing Company, $5 a year). The promise that it will be "a field of combat" where the many social, ethical, and political questions of the day will be fought over, seems likely to be verified, for among the contributors to the first two numbers are some of the most belligerent writers for the press who are now in the field. These are such as Robert G. Ingersoll, who opens the first number with an article on "God in the Constitution"; Lawrence Grönlund, who writes on "Nationalism"; Hugh O. Pentecost, on "The Crime of Capital Punishment"; Henry George, on the "Rum Power"; Rev. Minot J. Savage, W. H. H. Murray, Mrs. Mary A. Livermore, and Hudson Tuttle. Besides these serious discussions, *The Arena* offers papers on literary subjects, by Dion Boucicault, Louis Frechette, and others, and poetry and fiction by Joaquin Miller, W. H. H. Murray, Edgar Fawcett, and others. Each number is to have a portrait as a frontispiece; that of Dion Boucicault appears in the first number, and that of Rev. Minot J. Savage in the second.

In *Some Social and Economic Paradoxes*—a reprint from the "American Anthropologist"—Mr. *Lester F. Ward* sustains a number of theses, the contrary of which is now more currently held, such as that "The artificial is superior to the natural;" "Social activities may be artificially regulated to the advantage of society"; "Reforms are chiefly advocated by those who have no personal interest in them"; "Discontent increase with the improvement of the social condition"; "The means of subsistence increases more rapidly than population," and others on the relations of capital, profits, and wages.

A pamphlet published by E. Truelove, of London—*Home Rule and Federation* is its name, and *A Doctor of Medicine* its author—advocates the federation of nations on a plan resembling that of the United States as the cure or most effective palliative for existing social and political evils. It might begin with states already showing inclinations in that direction, like those of the Balkan Peninsula and Scandinavia; then bring in France and England, whereby, it is suggested, a solution of the Irish question may be found; and at last be made universal.

Some years ago Mr. *J. C. Pilling* undertook the compilation of a bibliography of North American languages; visited many public and private libraries, and corresponded extensively; and embodied the results of his researches in a volume of which a limited number of copies were printed and distributed. He has since continued his investigations, and has collected enough new material to lead to the belief that a fairly complete catalogue of the works relating to each of the more important linguistic stocks of North America may be prepared. Four catalogues of the new series have been published by the Bureau of Ethnology. The first of them is the *Bibliography* of the Eskimo language, which is spoken by a people covering a very extensive range of territory and widely scattered, and is represented in many dialects. The earliest date recorded in the bibliography is 1729, and it is brought down to include titles that came in while the work was in process of typesetting. Next in order is the *Bibliography of the Siouan Languages*, in preparing which the compiler enjoyed the advantage of the fact that many of those who have fashioned the literature of the language are still living, and he has had personal intercourse or correspondence with a number of them for several years. The publications of the Siouan group cover, perhaps, a wider range than those of any other linguistic group of North America. Nearly every dialect is represented in print or manuscript, either by dictionaries or extensive vocabularies, and pretentious grammars have been prepared of at least five of the languages. The third bibliography is of the *Iroquoian Languages* to which group, perhaps, belongs the honor of being the first of American languages to be placed upon record. The languages most largely represented are the Mohawk and Cherokee. Of manuscripts, mention is made of a greater number in Mohawk than in any of the other languages. Grammars have been printed of the Cherokee, Huron, and Mohawk; dictionaries in Huron, Mohawk, and Onondaga, and, in manuscript, of Seneca and Tuscarora. The *Muskhogean Languages*, to which the fourth bibliographical paper is devoted, are represented by 521 entries, of which 467 relate to printed books and articles and 54 to manuscripts.

Les Trois Mousquetaires—The Three Musketeers—of Alexandre Dumas is published by Ginn & Co., in an edition prepared for the use of schools, by Prof. *F. C. Sunichrast*, of Harvard College. This is one of the best works of the lively novelist, and belongs to a series to which Mr. George Saintsbury has ascribed remarkable and almost unique merits. But all of Dumas's works are liable to objection because of their containing passages unfit to be put into the hands of pupils. The present edition is an attempt to offer a condensation of the

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References to the United States Constitution, by *William E. Foster*, is published as No. XXIX in the series issued by the Society for Political Education, 330 Pearl Street, New York. Mr. Foster, Librarian of the Providence Public Library, is one of the scholarly men who seek to make the collections of books committed to their care of the largest possible public benefit. This pamphlet is an object-lesson in reading with a purpose. It gives clear references by chapter and page to everything in print having a bearing on the Constitution of the United States. We are given a list of the works showing the antecedent influences in antiquity, in German and English institutions, and in American colonial history. The more immediate causes are traced in the records of the Annapolis Convention, 1786, and the Philadelphia Convention, 1787. Next Mr. Foster analyzes the Constitution as framed and adopted, and shows the various sources of its articles. He then proceeds with Constitutional History since 1789, giving reference to all the leading expositions and commentaries on the Federal and State Governments, with notes on the various amendments, and on the comparisons of other governments with that of the United States. An appendix summarizes the decisions of the Supreme Court since 1865 on questions affecting national or State supremacy. Mr. Foster has performed his task with conscientious care and thoroughness. His *References* will save every student of the Constitution much unnecessary labor and bring before him much that he might never otherwise know. (Price, 25 cents.)

Prof. *Simon N. Patten*, of the University of Pennsylvania, in his pamphlet on *The Rational Principles of Taxation*, makes a debatable contribution to a difficult theme. He maintains that the wastes and burdens of competition in methods of distribution are increasing; the great cost of solicitation and advertisement in their manifold forms he holds to be the chief reason why science applied to industry has not enriched the nation as it should. His remedy for undue and wasteful competition is of a heroic kind; it is no other than an adaptation of the high-license plan in dealing with the retail liquor trade. Prof. Patten holds that while that plan deprives no patron of his desired beverages, effects no increase of prices, it results in notable economy to the community in extinguishing one half or more of the saloons, with their outlays for rent, attendants, and so on. He argues that a similar reduction of the ranks of all distributive classes by a high special tax would inure to a general promotion of prosperity in which these classes would perforce share.

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other hardly ten miles distant. While a number of the holiday observances are more or less common to all the Aryan natives, the features more peculiarly Irish are mainly derived from the old Druidic worship. Aside from some essentially foreign customs not noticed in Mr. Mooney's paper, many of the genuine Irish observances have been considerably modified by English influences. This is especially true of the May-day and Christmas celebrations; and many holiday rhymes and children's rhymes, riddles, and other formulas—even in the remote parts, where Celtic is the ordinary language of the people—have been imported bodily from England. Mr. Mooney has also reprinted, from the "Journal of American Folk-Lore," a paper on the "Folk-Lore of the Carolina Mountains," which, while it can hardly be summarized, is full of matters of curious and quaint interest.

Ants and the Plants that harbor them.—In a paper read before the British Association on the *Humboldtia laurifolia* as an ant-harboring plant, Prof. Bower observed that the peculiar relations between plants and ants had been the subject of considerable observation from time immemorial. The literature on the subject could be traced as far back as 1750, and Captain Cook, in describing his voyages, distinctly alluded to the matter. In one place he said that he had seen on a certain tree a number of black ants which perforated the twigs, and, after eating out the pith, formed a lodging in the cavity, and yet the tree continued in a flourishing condition. In tropical climates there were many plants pre-eminently associated with ants. The Italian botanist Picari contended that the relationship was advantageous alike to the plants and to the ants. The former afforded shelter to the latter, and in some cases supplied them with food. In the course of a short discussion Dr. Tieman said there were five species of *Humboldtia* in tropical countries. The ants took advantage of the hollowness of the plants, but he did not think the latter derived any benefit from their presence.

Alcoholism and Consumption.—In three professional papers Prof. Thomas J. Mays exhibits relations between consumption and nervous disorder, and between consumption and alcoholism. The former connection is illustrated by the citation of numerous cases in medical practice, the deductions from which lead to the conclusion that "he who looks at the disease which goes under the name of pulmonary consumption solely from a pulmonary standpoint obtains but a very limited and distorted conception of its magnitude and nature; but that he who takes the view here indicated will realize that the lung affection is only a special manifestation of the disease which invades the whole body; and that all its diversified symptoms, such as fatigue and exhaustion, anorexia, dyspepsia, wasting, dyspnœa, sweating, diarrhœa, hæmoptysis, intercostal tenderness, hoarseness, aphonia, œdema, are not the consequences of the pulmonary disease, as is generally believed, but in all probability find a common bond of union in a general disorder of the peripheral nervous system." In the other aspect of the theory cases are cited to prove that "alcoholism and phthisis are not mere coincidences, but that they have a relationship so intimate that one may be converted into the other"; and that pulmonary phthisis can be produced through the toxic action of alcohol on the nervous system. "Such, then, being the relation between alcoholism and pulmonary phthisis, it is very readily understood why these two diseases should so frequently change places in different members or generations of the same family, and why they are so often associated with various other nervous disorders."

Old Panama Canal Projects.—The feasibility of cutting a canal across the Isthmus was discussed by William Paterson, in 1701, in connection with his Darien scheme, but only incidentally. He thought that the canal could be easily cut for six out of the eight leagues between the oceans, while the other two passages would be difficult. Humboldt, in a report made in 1799, enumerated nine different points at which the two oceans might be connected. Previous to this, in 1788, a passage between the two oceans for small craft was actually accomplished. The author of this achievement, says Mr. J. Stephen Jeans, in a paper on the subject, was the curate of Nevita, who induced his Indian flock to cut a trench between the upper streams of the San Juan River, near

Chirambira Bay, and the higher waters of the river Atrato, which flow into the Atlantic through Choco Bay, in the Gulf of Darien, so that they could pass from the Caribbean to the Pacific in their canoes. In carrying this passage into effect, the Arastradera, or summit level, a plain about three miles in width, formed by an interruption of the mountainous ridge, was cut across. The passage was, however, dangerous and difficult at all times, even for canoes, and the communication has now for many years been neglected and disused.

Land Tenures in China.—While the emperor theoretically owns all the land in China, the private owner has as absolute a property in it as he can have under any government. The tenures are military and common, the latter applying to far the largest proportion of the territory. It exists upon the conditions of payment of the land-tax, the supply on demand of statute labor to the authorities, and the payment of a fine on alienation. The land-tax is assessed in a fixed sum on the district magistrate, who recovers from the tenant, but is sometimes remitted in case of a great calamity. The supplying of statute labor has almost fallen into disuse. The fees are payable on the transfer of land by sale or mortgage, succession or inheritance. About half the soil is probably the property of the tenants who till it; but large tracts are also owned by "literati and gentry," who lease it to small farmers for a rental consisting of a proportion of the crops fixed according to the quality of the soil. The rents are paid as soon as the crop is harvested, and, being seldom in arrear, evictions are rare. The laws are all in favor of the tenant, who pays no taxes or rates, and takes everything, including his house. There is every possible variety of arrangement in the ownership of land. There are absolute sales and sales in which the vendor reserves the right to a share in a future rise in value; revocable and irrevocable sales; and dual ownership, in which one man owns the surface and the other the soil, and is liable for the taxes.

Refrigeration by Ammonia.—Ammonia has been very generally employed for refrigerating purposes in the United States and Germany, and to some extent elsewhere, for ten years or more. Other agents used for this purpose are methylic ether, Pictet's liquid, sulphur dioxide, and ether. Ammonia in its anhydrous condition possesses in an eminent degree the properties most desired in a refrigerant, for it boils at the low temperature of 37½° Fahr., while its latent heat of vaporization is 900°. Two distinct systems are employed in the use of ammonia, differing from one another in the method of securing the rejection of heat during condensation of the vapor, while the mere evaporating or refrigerating part of the process is the same in both. In the absorption process ammonia and water are vaporized together and then fractionally condensed by cooling. The water, condensing first, is caught and run back to the generator, while the nearly anhydrous ammonia is collected separately. With this process 200,000 units of heat per hour may be eliminated by the consumption of about one hundred pounds of coal, with a temperature in the refrigerator of about 20° F. In the compression process the ammonia vapor is drawn from the refrigerator and compressed by a pump and delivered into the condenser and liquefied at the temperature of the cooling water. It is more economical than the absorption process, and is adequate to the elimination of 240,000 units per hour. The process is applied to ice-making and to the cooling of stores and rooms.

The Tahl-tan Indians of British Columbia.—An account of this people by Mr. J. C. Callbreath, included in a report of an exploration by George M. Dawson, gives their maximum height as about five feet seven and a half inches, and maximum girth of chest about thirty-seven inches. Their heads are small, and the feet and hands are generally small, as are also the wrist and ankle, especially in the women. Traders sell more No. 2 women's and No. 6 men's shoes than any other sizes. No men's hats above No. 7 are sold. Half-breeds from a white man and a Tahl-tan woman are more like the father than the mother, and three generations where the father is in every case white seem to obliterate all trace of Indian blood. The children are more cunning and clever when young than those of the white race, but grow dull as they age. Yarn is spun from the wool of the mountain goat and is woven into excellent blankets, which are highly colored and ornamented. The process of boiling water with hot stones in baskets or wooden bowls was formerly common. The dances of the Tahl-tan are tame affairs compared with those of the coast tribes, but their musical capabilities are considerable. Kinship, so far as marriage or inheritance of property goes, is with the mother exclusively, and the father is not considered a relative by blood. Mr. Callbreath tells of an instance where a rich Indian would not go out or even contribute to send others out to search for his aged and blind father who was lost and starving in the mountains. Not counting his father as a relative, he said, "Let his people go and search for him." Yet this man was a more than average good Indian. A man's female children are as much his property as his gun, and he sells them to whom he pleases. If the husband pays for his wife in full and she dies, even ten years afterward, the father is bound to supply a wife, if he have any more eligible daughters, without additional payment. Their laws are based on the principle that any crime may be condoned by a money payment. Their religious belief was simply what their medicine-men might lay down for them from time to time, and the idea of a Supreme Being was very obscure if not altogether wanting. They have no fear of death except from dread of the pain of dying. There is a belief propagated by their medicine-men that the otter gets inside their women and sometimes causes death by a lingering illness, in other cases allowing the woman to live on till she dies from some other cause.

An African Tribe of Promise. — The Benge are a very intelligent and pleasant tribe which Lieutenant R. Kund's exploring party found occupying an "immense clearing" in the midst of the Congo wilderness. Their village, surrounded by large manioc-fields, consisted of a street about fifty yards wide extending farther than the eye could reach. The huts of the villagers squarely faced the street on either side, and behind them were well-kept plantations of bananas, backed by oil palms, with the giant trees of the forest looming in the rear of all. The race is of a very fine type, with a brownish-red complexion some degrees removed from black, fine, manly features with an intellectual cast, and cleanly and orderly in habits. They are good hunters, and practice wood-carving and other arts with a skill that would do credit to Europeans. They have attained in all respects a higher standard of civilization than is to be found among the other tribes of West Africa. They exhibited none of the stupid superstition in the presence of the travelers which had appeared in other places, and showed no signs of cannibalism or fetichism or coarse idolatry.

Effect of a Cobra's Bite.—The taxidermist of the Victoria Museum was bitten in the hand by a cobra, from which the poison-bag had been extracted, while feeding it. Supposing the bite to be harmless, he took no notice of it till pain and nausea began. Then all the usual antidotes were tried without effect. The man lost the power of speech, became paralyzed in his muscular system, and ceased to breathe. Artificial respiration was applied for eight hours, after which he began to breathe again and gradually regained consciousness. After two days he was able to tell his friends that he had been fully aware of all that was going on during the efforts to restore him, but had not been able to move a muscle or to make his feelings known. He could see and hear and feel, but not move or twitch. He was afterward attacked by high fever and inflammation of the lungs, from which he died on the Sunday following the Wednesday on which he was bitten.

Dust essential to Fogs.—Nearly ten years ago John Aitken, of Edinburgh, proved experimentally that the presence of dust was essential to the formation of fog and cloud. He connected two receivers, one containing common air, the other air freed from dust by passing through cotton-wool, with a boiler. When steam was admitted into the first receiver, a fog formed within it; but when allowed to enter the one containing filtered air, not the slightest cloudiness was produced. Particles of water-vapor do not combine with each other to form a cloud-particle, but must have a free surface on which to condense. The particles of dust serve as nuclei on which the vapor condenses, and hence the more abundant the dust the more dense the cloud. When the vapor in the second receiver was brought by circulation against the sides of the receiver, it gradually condensed on these surfaces. The density of the fog formed in common air shows what a large amount of dust is present every day in the air around us. But the particles of fog do not represent all the dust-particles in the air. If enough steam is blown into a receiver full of common air to produce a dense fog, and after the fog has settled more steam is blown in, another fog will form on the dust which still floats in the air. If this is repeated a number of times, a less dense and coarser-grained fog forms each time, till at last no fog is seen, but the condensed vapor falls as rain. These dust-particles are not the motes that we see in the path of a sunbeam; for, when common air is passed through a flame, these motes disappear, but the air still remains a good medium for fogs. It is a finer kind of dust which furnishes the fog and cloud nuclei. The products of combustion are fog-producers, and especially the vapor from the burning of sulphur.

Gem Minerals of Canada.—Although, according to Mr. George F. Kunz's paper on "Precious Stones, Gems, and Decorative Stones in Canada and British North America," Canada can hardly be called a gem-producing country, it furnishes a number of stones that are of more than passing interest to the mineralogist, and of some value in jewelry and the arts. A number of gem minerals, not of gem quality, are found in examples of such size and perfection that they have been given prominent places in cabinets, and are even more prized as specimens than cut stones from other localities. Their mineralogical value gives them no small commercial importance. Of such are magnificent zircon crystals, occurring as individuals up to fifteen pounds in weight, and many finer ones weighing a pound, as well as beautiful twin crystals of the same mineral; black titanite in simple and trimmed crystals up to seventy pounds each; "vast quantities of amethyst" from Lake Superior; ouvorsovite or green chrome garnet from Orford, and white garnet crystals from near Wakefield; and apatite crystals, one weighing over five hundred pounds, of great beauty, of which the rich green variety, especially, would do to work into ornaments similar to those made from fluorite. Only a small part of the territory of the Dominion has been examined with reference to these stones; and with the discovery of new localities important additions to the list may be anticipated.

The Sliding Railway.—The *Chemin de Fer Glissant*, or sliding railway, at the Paris Exhibition, according to a description by Sir Douglas Galton in the British Association, is based on the two principles of causing the carriage to slide on a thin film of water introduced between the sledge-plates on which it rests; and the propulsion of the sliding train by horizontal columns of water acting through hydrants placed at intervals on the line. The system was originally designed by Girard in 1861, who made a line at his own private house, where he had an inclination of one foot in twenty. The results he obtained seemed to justify the application of the system in special cases on a paying basis. He acquired a concession in 1869 for a railway from Calais to Marseilles, to which a subvention was afterward attached. But the War of 1870 resulted in the destruction of the railway by the German army, and in the death of M. Girard in 1871. In 1885 M. Barré purchased the drawings left by M. Girard, and introduced an improvement which he considered would make the system more workable. A line on this improved system was established in the Paris Exhibition, about two hundred yards long, and trains were run upon it.

Properties of the Kola-Nut.—Kola-nuts, or the seeds of *Sterculia acuminata*, are allied in composition to cocoa, coffee, and tea, but contain a relatively large amount of caffeine. They are credited with strong tonic and nervous stimulant properties; with counteracting and removing the sense of exhaustion after fasting and fatigue; with having antagonistic reaction to alcohol; and with a purifying influence on water. Their value as a therapeutic and dietetic agent has been tested by Surgeon R. H. Firth, who concludes that kola is not a food; that it increases total urinary water, has a stimulant action on the nervous system, temporarily strengthens the heart-beat, and increases the arterial tension. In times of exertion and fasting it wards off the sense of mental and physical depression and exhaustion. The author has not gained positive results respecting its therapeutic qualities. Its action in purifying water is mechanical, and not more effective than that of other mucilaginous seeds.

Raining Spiders' Webs.—Falls or showers of gossamer spiders' webs have been recorded in different parts of the world. White describes several in his "Natural History of Selborne." Darwin mentions a shower which he observed from the deck of the Beagle off the mouth of the Rio Plata, when the vessel was sixty miles from land. A general fall of spiders' webs is said to have been noticed a few years ago in some of the towns of Wisconsin, which seemed to come from over the lake. The webs were strong in texture, very white, varied from sixty feet in length to mere specks, and were seen as far up in the air as the power of the eye could reach. The shower may have been due to an unusual excursion of the familiar geometric spider, a species which has the same power as the gossamer of shooting webs that float upon the air, and sometimes serve as an air-raft for the producer.

NOTES.

THE scientific courses at Indiana University, of which our contributor, David Starr Jordan, is president, include departments of physics, with classes in physics proper, physical measurements, and meteorology; chemistry, with qualitative and quantitative analysis, special work, and water analysis; geology, with mineralogy, topographical geology, and field-work; zoölogy, with many classes, including theories of evolution, the critical study of Darwin's "Origin of Species," and original research; and botany, with six classes and advanced and original work in the senior year on a special subject. Since it was opened 3,816 students have been taught in the college departments of the university.

"COCOANUT DAY" is celebrated in most parts of India during the full moon in August. On that day numbers of nuts are thrown into the sea as an offering to the Hindoo god. Occasionally one meets with deformed nuts, consisting of the husks with small nuts having no kernel inside. The natives attribute this blighting to the tree-frog, which, by smelling the flower, can prevent the fruit from coming to maturity.

A CURIOUS survival of customs was illustrated in Lisbon some days after the funeral of the late King Luis of Portugal. A funeral procession, composed of officers, military, and citizens, marched through the streets to places where platforms covered with black cloth had been erected. Four shields, on which were painted the royal arms, were borne aloft on long staves. On arriving at the platforms, the principal persons took their places upon them; one of the shield-bearers, advancing to the front and chanting, "Weep, O Portuguese, for your king, Dom Luis I, is dead," dashed his shield to the ground with such violence that it was shattered. This was repeated at each platform, while the bells were tolled during the whole ceremony. The proceedings were closed with a requiem service.

AT the recent annual meeting of the Rational Dress Society, Viscountess Harberton, the president, said that during the past year she had hardly met with any expressions of approval from women with regard to their present system of dress. Most of the remarks she had heard had been denunciatory of the weight, discomfort, or dragging, or—particularly from young women—the cold when evening dress was worn. This was cheering, because it marked a growing realization of the uncomfortableness of present costumes. In the speaker's opinion, the only hope of reform lay in a radical change to some kind of dress having the clothing for the legs dual; it should clearly follow the shape of the form it was meant to cover.

ACCORDING to Mr. R. Andree, our Indians use rising smoke as a means of giving signals, and have a system of alternately smothering the column and letting it rise freely for transmitting different messages. A similar method is used in New Guinea and Australia. The great variety of the messages communicated by drums in the Cameroons and other parts of Africa have been described in the "Monthly." The Gallas, south of Abyssinia, have drums stationed at certain points of the roads leading to the neighboring states, at which watchmen are appointed to sound the alarm in case of threatened invasion. In New Guinea the natives learn from the rapidity and rhythm of the blows on drums what is happening—whether an attack, death, or a festival.

THE opinion is expressed by Mr. Elliot, in his last Meteorological Report for India, that the period of minimum sun-spots is associated in that country with the largest and most abnormal variations of meteorological conditions and actions. Thus the snow was exceptionally heavy in the northwest Himalayas in the winters of 1866, 1876, and 1877. The most striking and disastrous famines have also occurred near the minimum sun-spots, as those of Orissa in 1866, Behar in 1874, and Madras in 1876–'77. So, too, with cyclones, as at Calcutta in 1864, when sixty thousand people were drowned in the storm-wave, and Backerganj in 1876, when one hundred thousand were drowned.

The experiment has been tried in Moscow, Russia, with success, of using carrier-pigeons to convey negatives of photographs taken in a balloon. The plates were packed in light-proof papers and tied to the feet of pigeons, who speedily took them in good order to the station on the ground.

Medical geology and climatology are mentioned by the "Lancet" as departments of the science to which more attention might be paid than is. Their usefulness is illustrated by the recently published studies of Mr. Alfred Haviland on the distribution of cancer in the British Islands.

The undue increase in all the learned professions in Germany is the subject of a pamphlet by Prof. W. Lexis, of Berlin. All the theological faculties, except the Roman Catholic, are increasing "to an alarming extent." The average number of medical students for the whole empire—2,675—was increased in 1888–1889 by 2,344. If a proportionate increase takes place in the number of licenses, the year's new doctors will rise from the average of 456 to more than 800. A prize offered by one of the Teachers' Associations for the best essay on the overcrowding of the learned professions and the means of remedying it, was given to two papers out of seventy-six sent in, which are to be published in a book.

An apparatus for providing a steady platform at sea for guns, search-lights, telescopes, etc., was described by Mr. Beauchamp Tower in the British Association.

OBITUARY NOTES.

Ex-President Martin B. Anderson, who died at Lake Helen, Fla., February 26th, was a scholar who had made himself eminent in many fields of thought and activity. He was born in Brunswick, Maine, in 1815; was graduated from Waterville College, now Colby University, in 1840; studied theology; preached, taught, and served as editor of the "New York Recorder," a Baptist paper, till 1853, when he was chosen President of the University of Rochester, where his after-life was spent. He instituted a course of lectures in intellectual philosophy, which were continued till he retired, in consequence of ill health, a year or two ago; also a course of historical lectures; and under the head of political economy he treated various questions affecting money, taxation, etc., and free trade and protection. His studies extended to questions of constitutional law, and covered the arts. He was prominent in all Baptist denominational enterprises, and served the State on several civil commissions. In fact, as the "Evening Post" well says, "he was one of those men who take all knowledge for their province, and never wearied of enriching his mind with stores of all descriptions, which he distributed with lavish impartiality among the students under his charge."

Among the recent deaths of scientific men abroad are those of M. L. Taczanowski, of Warsaw, a distinguished ornithologist, author of a book on the birds of Peru; M. Neumayr, of Vienna, geologist, who was not yet forty years of age; and M. Otto Rosenberger, astronomer, who had been connected with the observatory at Halle since 1831.

"La Nature," of February 15th, mentions the death of M. Buys Ballot, of Utrecht, one of the most eminent meteorologists of the time, at the age of seventy-three years. He gave much attention to the study of data for facilitating weather predictions — the movement of cyclones, the direct observation of clouds, and all the "natural symptoms of the weather." He propounded several meteorological laws or maxims which bear his name, and probably had an equal part with any other student in giving shape to the present system of observation and investigation in that science.

Major Peter Egerton Warburton, whose name is associated with the hazardous but successful expedition which he made across Australia in 1873, died recently in Adelaide, in his seventy-sixth year. His exploring party suffered terrible privations during their march, and were not heard of for twelve months. Major Warburton received the gold medal of the Royal Geographical Society and various honors in recognition of his contributions to our knowledge of Australia.

Sir Henry Yule, an Englishman, eminent in geographical research, died December 31st, in his seventieth year. In his annotated edition of Marco Polo's travels he made contributions of the most valuable character to geographical and antiquarian lore.

M. Eugène Deslongchamps, a French paleontologist, who died last December, was the son of another paleontologist, Prof. Eudes Deslongchamps, was Professor of Zoölogy and Paleontology at Caen, and was the author of several memoirs on the paleontological fauna of Normandy.

Dr. Karl Eduard Venus, an eminent German entomologist, died at Dresden, December 13th. He was the founder of the Entomological Society "Iris" at Dresden.

M. Gustave Hirn, an eminent French physicist, mathematician, and astronomer, died January 14th, in the seventy-fifth year of his age. He was the author of a work of considerable repute on the "Constitution of Celestial Space."

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